JULY, 1906 TEN CENTS

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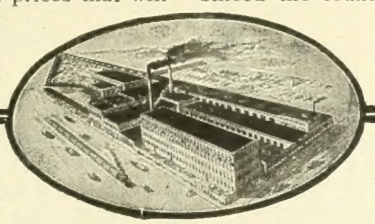

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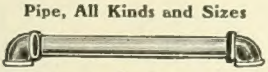

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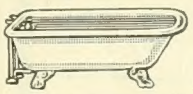

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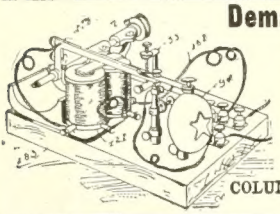

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# The TECHNICAL WORLD MAGAZINE

## TABLE OF CONTENTS

## JULY, 1906


| | Page |
|---|---|
| **Frontispiece. Grand Canyon of the Colorado.** To possible astronomers on Mars, this vast rent in the Earth's surface would be conspicuous. | |
| **Are There Men on Mars?** By PROF. WM. H. PICKERING, Harvard University Observatory | 459 |
| **Wireless Telegraph.** Poem. By DON MARQUIS | 473 |
| **On the World's Last Frontier.** By RICHARD A. HASTE | 474 |
| **Canning California Breezes.** By WILBUR BASSETT | 493 |
| **The Gold Seekers.** By D. A. WILLEY | 498 |
| **Making Good.** Poem. | 504 |
| **Electricity as Housemaid.** By SIDNEY JAMES | 505 |
| **What Strength is For.** Poem. By ERNEST CROSBY | 511 |
| **Street-Railways which Repair Themselves.** By HENRY HALE | 512 |
| **Uncle Sam's Oversight.** By ELLIOTT FLOWER | 518 |
| **Passing the Fire Test.** By HOLLIS W. FIELD | 527 |
| **Motor-Trucks Driving Out Draught Horses.** By DAVID BEECROFT | 534 |
| **Making Silk Out of Gun-Cotton.** By CLARENCE HUTTON | 542 |
| **Consulting Department** | 545 |
| **Engineering Progress** | 549 |
| **Blowing Off Steam** | 554 |
| **Engine No Bigger than a House-Fly.** By T. H. ROBINSON | 556 |
| **Where History Was Made** | 558 |
| **Science and Invention** | 560 |
| **Chalk Talks.** No. XXIX. The Negative. By CARL S. DOW, S. B. | 566 |



**THE TECHNICAL WORLD MAGAZINE** is a monthly magazine, published the fifteenth of each month, preceding date, devoted to the problems of the technical and industrial world, and a treatment of all matters of interest in Applied Science.

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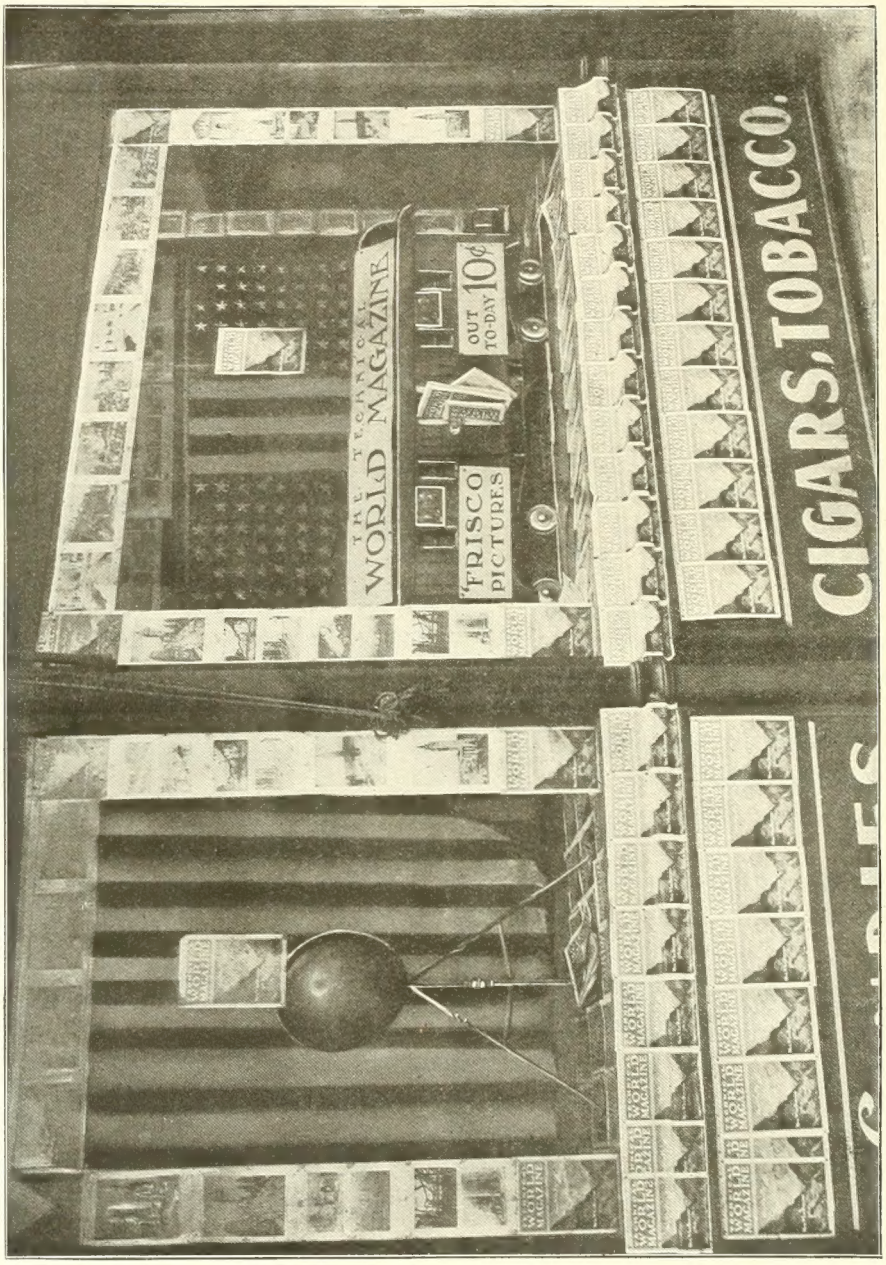


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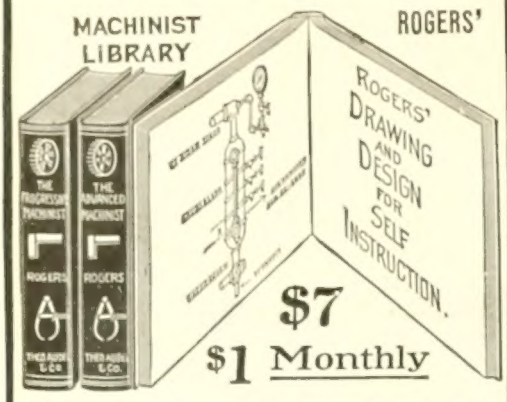


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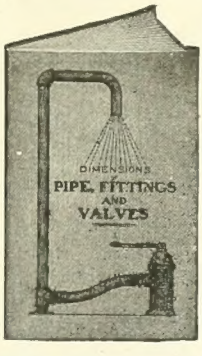


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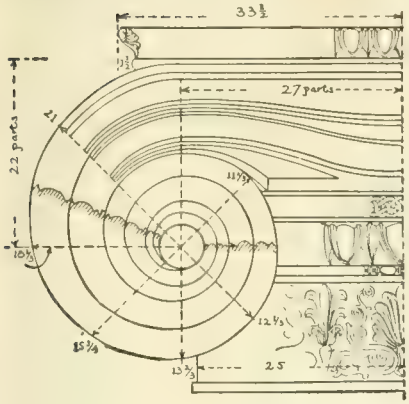


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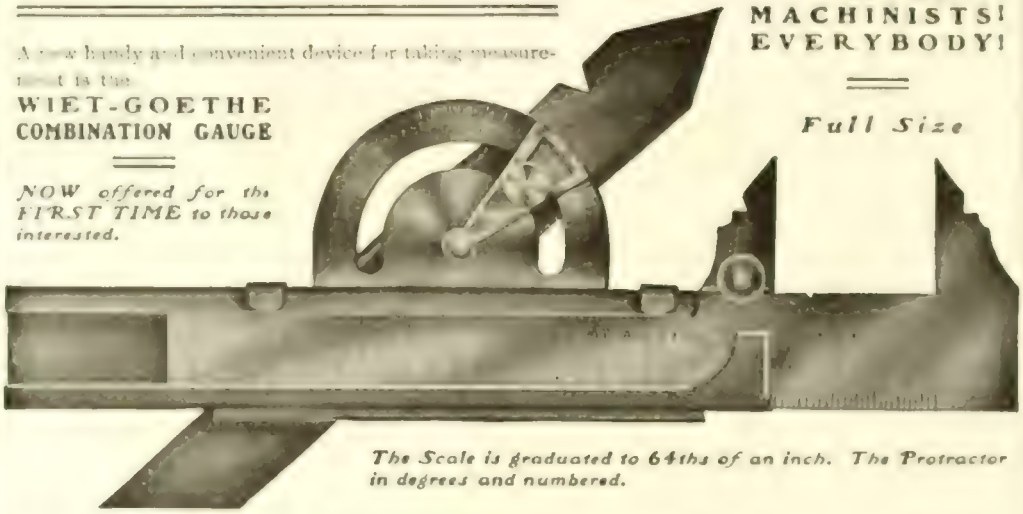

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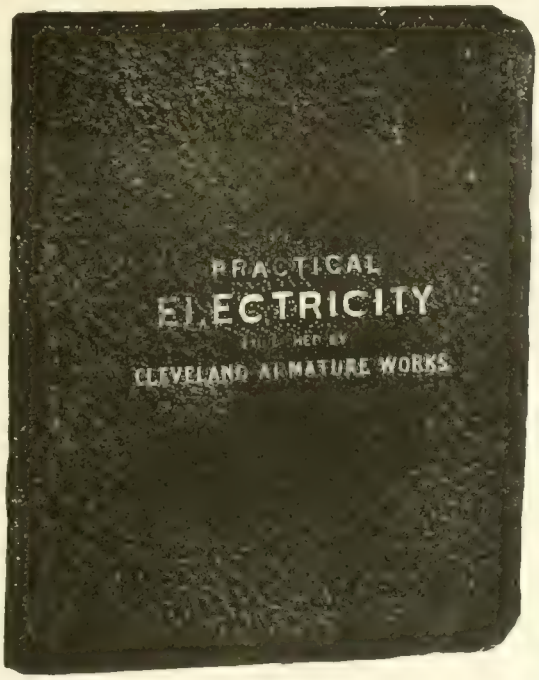


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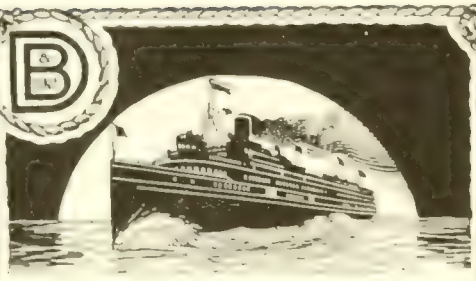

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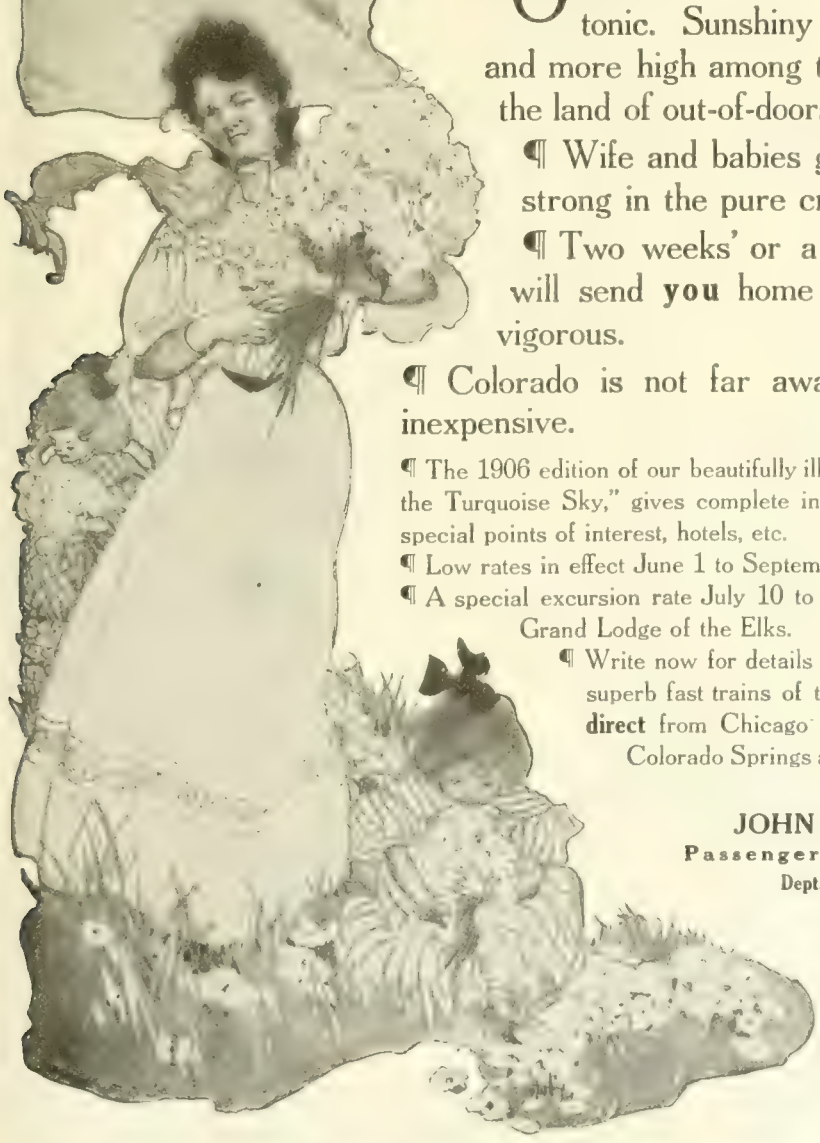

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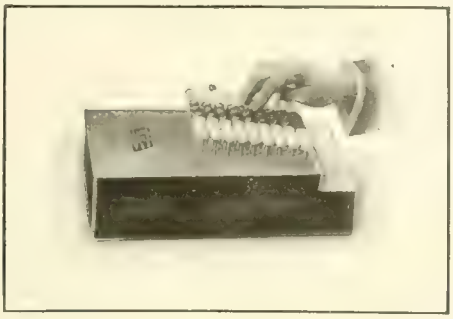

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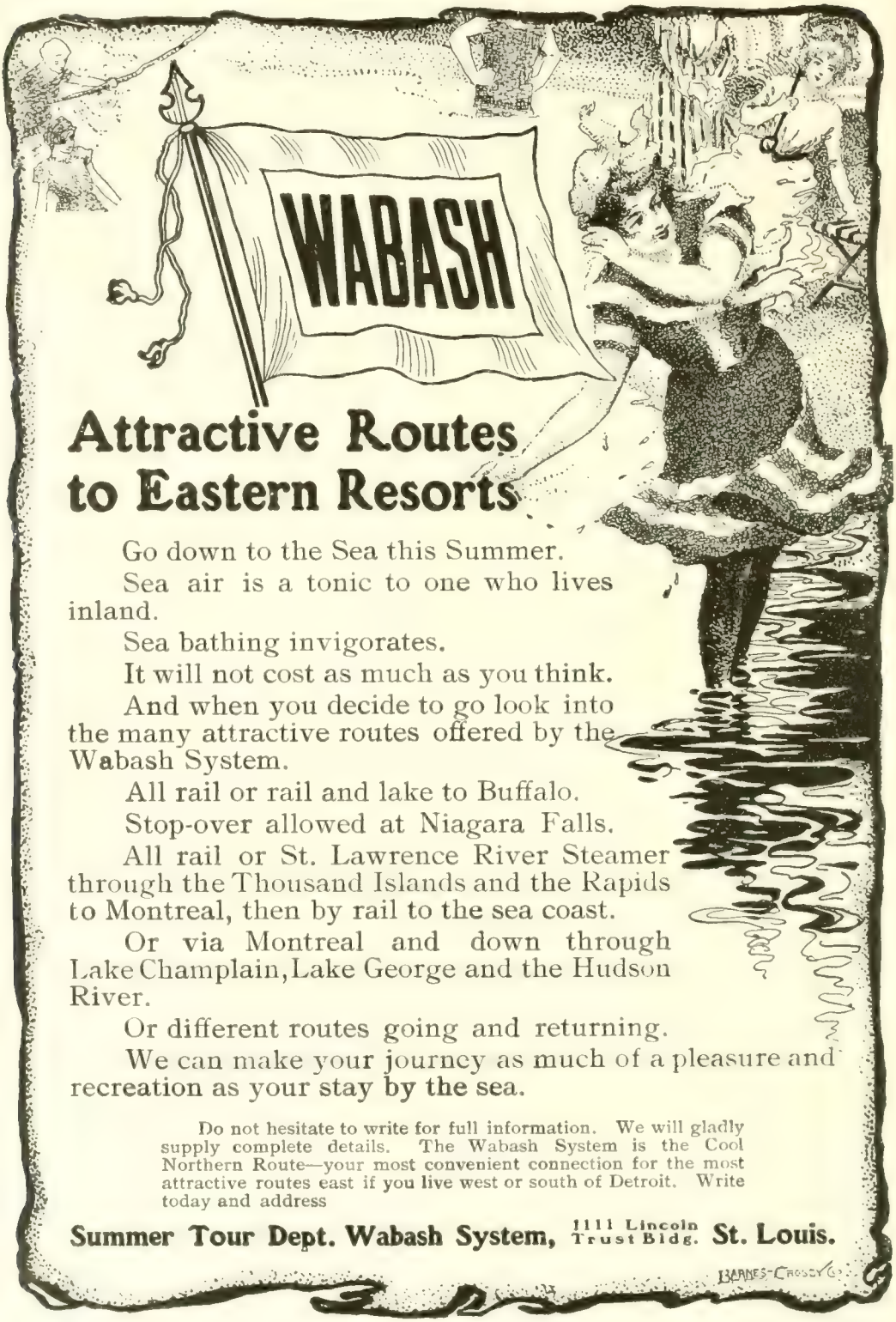


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THE EARTH AS VIEWED FROM MARS

The chief argument for the existence of men on Mars is based on the fact that the surface of the planet is marked by deep canals, which appear to be artificial and the work of conscious intelligence. If there are astronomers on Mars, who are studying the Earth, one of the most conspicuous objects revealed by their glasses would probably be this Grand Canyon of the Colorado, which is thirteen miles wide, one mile deep and two hundred and fifty miles long. It would appear as a great canal on the surface of the Earth.

# THE TECHNICAL WORLD MAGAZINE

Volume V JULY, 1906 No. 5


# Are There Men on Mars?

## By Prof. Wm. H. Pickering


Astronomical Observatory of Harvard University


*Are there men on the planet Mars?*

*[illegible] trying [illegible]*

*[illegible] Mars [illegible] scopes are being trained in the hope of discovering this great secret.*

*[illegible] the atmosphere [illegible]*

*[illegible] intelligent beings.*

*But is there any actual proof of the existence of such a race?*

*The two greatest authorities on the subject in America—perhaps in the world—are Prof. William H. Pickering of the Astronomical Observatory of Harvard University, and Prof. Percival Lowell, whose private observatory at Flagstaff, Ariz., is [illegible]*

*Professor Lowell leads the important group of astronomers who hold that it is extremely probable—if not absolutely proved—that Mars is inhabited by highly civilized beings. He bases his contention chiefly on the fact that the surface of the planet is criss-crossed by a series of extremely regular and apparently artificial canals, through which water is conveyed from the polar oceans to the otherwise dry and arid regions corresponding to our temperate and torrid zones.*

*There is another group of astronomers who hold that these canals—the existence of them is not denied—are only cracks caused by the shrinking of the planet, and are not the work of any conscious intelligence.*

*Between these two groups stands Professor Pickering, perhaps inclining a little towards the probability that Mars is inhabited, but still open to conviction. THE TECHNICAL WORLD MAGAZINE is fortunate in being able to present to [illegible] about the nature and the possible inhabitants of the nearest of the planets, during observations which have extended over [illegible]*

DURING the next three years the planet Mars will twice approach nearer to the Earth than has been the case since 1892. It will, therefore, be a very conspicuous object in the heavens, equaling Jupiter in brilliancy, and will excite considerable attention from astronomers in various parts of the world.

### The Orbit of Mars

To understand why, unlike the case of the other planets, these near approaches occur only at such long and irregular intervals, let us imagine the larger circle (Fig. 1) to represent the orbit of Mars, and the smaller one the orbit of the Earth, the Sun being at *S*. These orbits are not really circles, but ellipses, the Sun being


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a little to one side of the exact center in each case. The intersections of the two inclined diameters *PA, pa,* with the orbits, show where the planets are nearest and farthest from the Sun. When Mars is nearest the Sun, it will be seen that the Earth is nearly at its greatest distance, which brings the two orbits closer together there than elsewhere.

The Earth moves in its orbit much faster than Mars, and also has a shorter distance to travel; it therefore overtakes Mars once in a little over two years. When this is the case, the two planets are much nearer together than at other times. Mars then rises just at sunset; and since it is in the opposite part of the sky to the Sun, it is said to be in *opposition.* In the figure, the short lines connecting the two orbits show where the different oppositions have occurred. In that of 1892, the two planets were very near together; in 1894 they were somewhat farther apart; but no favorable opposition has occurred since then. The next one will take place in 1907, and will be a little better than that of 1894. The distance of Mars from the Earth will then be 38,200,000 miles, while the shortest possible distance is 35,000,000 miles. The most favorable oppositions occur in the latter part of August.

The parts of the Martian orbit marked *n* and *s* in the figure, show when the planet's poles are pointed most nearly towards the Sun. Thus at *s* is the south-

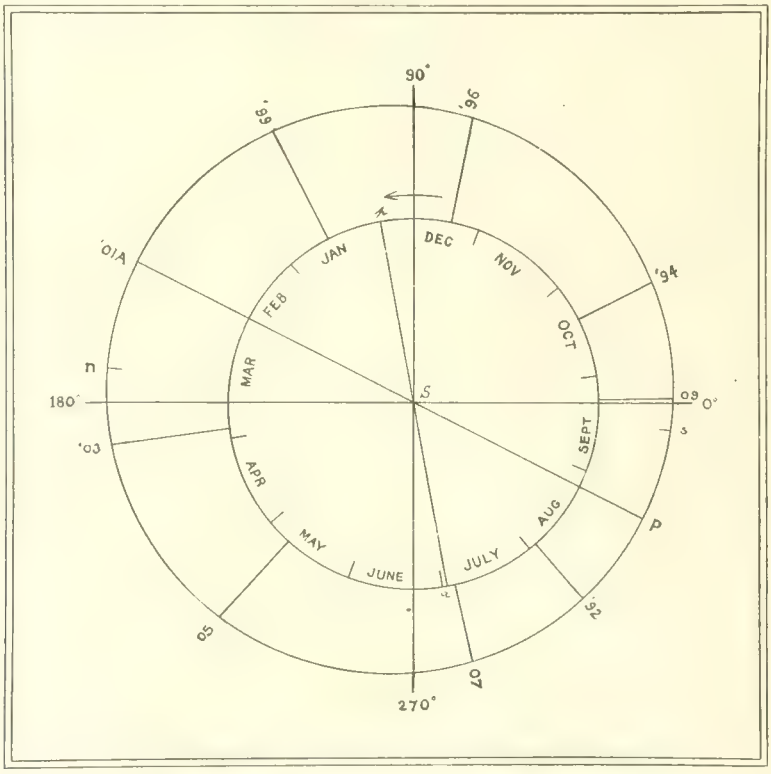



FIG. 1. ORBITS OF THE EARTH AND MARS

ern summer and northern winter. Since the planet is here so much nearer the Earth than at *n,* it is possible for us to see the details of its southern hemisphere very much better than we ever can those of its northern one.

The inclination of the equator of Mars to its orbit is 24°, or about the same as that of the Earth. The seasons on the two planets are therefore identical, except that, on account of the longer year, those on Mars are twice as long as our own. The Martian day is about forty minutes longer than ours.

**Gravitation, Water, and Atmosphere**

The diameter of Mars is 4,200 miles, or a little over half that of the Earth. Its mass, or the amount of matter it contains, is 0.12 as compared with that of the Earth; and the force of gravity at its surface, 0.38, or about two-fifths that at the surface of the Earth. A man weighing 150 pounds on the Earth would weigh rather less than 60 pounds on Mars, and could accordingly be much more active. He could jump much higher and throw a stone two and a-half times as far. It will be noticed that he could not move the stone any faster than he could upon the Earth; merely, it would take longer to fall, and therefore would go farther before striking the ground.

The effect of this small constant of gravitation has a most important influence on the physical conditions at the surface of Mars. Bodies where this constant is large, like the Sun and stars, can retain enormous atmospheres of the lighter gases, like hydrogen and helium, which escape at once into outer space from the Earth's atmosphere. Bodies where the constant is small, like our Moon, lose nearly all their atmosphere, save such components as are being constantly liberated from their interior, like water vapor and carbonic acid. Mars, where the constant of gravitation lies between those of the Earth and Moon, must have an atmosphere intermediate in its density and composition. That its atmosphere contains water vapor, we

PROF. WILLIAM H. PICKERING.
Harvard University Astronomical Observatory.

know, because we see it frozen at its poles in the form of ice, and later melted to form water. It is sometimes suggested that this white material, which increases in winter and diminishes in summer, may be carbonic acid; but this cannot be the case, since carbonic acid does

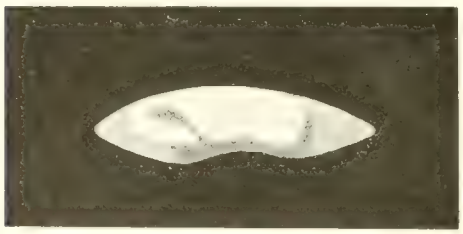


FIG. 2. SOUTH POLE OF MARS, SHOWING WHITE POLAR CAP.
From a drawing by the writer.

not become liquid at pressures of less than five atmospheres, no matter what the temperature may be. The atmosphere of Mars, we know, is very rare; therefore the liquid we see surrounding the melting ice-caps cannot be carbonic acid. There is no substance known, save water, that would meet these conditions; therefore, if the polar caps of Mars are not due to ice, they must be caused by some substance that is not found upon the earth—which conclusion is improbable.

Water is nevertheless very scarce on Mars; and its oceans, if it has any, are shallow and only temporary, existing solely at the times of the spring freshets. In Fig. 2 is shown the south polar cap after the ice has begun to melt. Below, and to the right of it, is seen a very dark area, which the polariscope shows differs from the rest of the planet in that it has a shiny surface.* In the springtime, shortly after the ice has begun to melt, this dark area forms a ring surrounding the ice, measuring some two thousand miles in diameter and in some places over two hundred miles in breadth. As the ice-cap diminishes in size, the black border retreats with it towards the pole. This leads us to believe that the black area is due to a swamp or a collection of swampy pools and streams, rather than a sea. Within the ice-cap is seen a lake connected with the swamp by a narrow strait.

If the ice-cap, when at its maximum size, contains the larger part of the total water supply of the planet, it will not be difficult to form an idea of its volume. Let us assume that the mean depth melted by our Sun in four of our months over the whole area is twenty feet, and that the ice has the consistency of snow. This, when melted, would give us a lake 2,000 miles in diameter and two feet in depth. This would be about the amount of water contained in one of our great lakes. One thousand times this amount would be insignificant compared to our terrestrial oceans.

Probably water would not now be found on the planet at all, if, as in the case of our Moon, it were not constantly renewed from the interior. Fresh supplies are thus gradually taking the place of that which is being slowly dissipated into space. Sooner or later these supplies must be exhausted; and then, if not before, all life on both these bodies must cease. On our Earth too, when our volcanoes cease to evolve carbonic acid, plant life, and with it all animal life, must necessarily come to an end.

Oxygen and nitrogen may exist upon Mars, but probably in small quantities. Campbell has shown by spectroscopic evidence, that the density of the Martian atmosphere cannot exceed one-quarter that of our own, and is probably much less. The existence of water in the liquid form shows that the density of the Martian atmosphere must exceed 1-150 that of the Earth. As far as we know at present, therefore, the equivalent pressure of the Martian atmosphere is less than 7.5 inches, and is more than 0.2 inch. The light and absorption visible at the bright edge of Mars indicate that the true value lies nearer to the upper of these limits than it does to the lower one. The lowest pressure at which man can live, as shown by recent experiments made by inhaling oxygen and carbonic acid combined, is about 5 inches; and that is probably only for a short time; but doubtless an intelligent race might be slowly evolved, capable of sustaining life at still lower pressures.

*Astronomy and Astro-Physics, 1894, XIII, 554.

### Climate and Meteorology

The fundamental fact on which we must base our knowledge of the climate of Mars, is the melting of its polar snows. Where these are melting, the temperature must be 32° F.; and nearer the equator it must be warmer. The climate of the Earth is tempered by our great oceans. Otherwise our summers would be much hotter, and our winters much colder. In the heart of the continents, the extremes are much greater than on the coast. On Mars, where there are no permanent oceans, the extremes must be greater still. Our atmosphere also serves to moderate our climate. On high mountain summits, the extremes are much greater than at sea-level. The comparatively rare atmosphere of Mars must be of little use in this respect.

Certain causes tend to raise the mean temperature of Mars. The relatively large amount of cloud and illuminated snow areas of the Earth, cause a great waste of heat by reflection, which does not occur upon Mars. If the nights of Mars are comparatively cloudy, as may be the case, these clouds would help to protect the planet from radiation into space during that portion of the Martian day, and thus also tend to raise its temperature.

In the summer season, on account of the rare atmosphere and the lack of water, the arctic regions on Mars must enjoy a temperature but little lower than that of the torrid zone, but during the long winter night the polar cold must be intense, and but little removed from absolute zero—that is –460° F. As to the highest temperature experienced on Mars, we have no information, but may suppose it to be inferior to that found upon the Earth. In the torrid zone, humanity would possibly find the range of temperature disagreeable, but probably not unbearable. Even in the polar regions, vegetation, if not animal life, might exist, much as it does with us.

The clouds of Mars for some unknown reason appear yellowish in color. On the surface of the disc, although visible, they are not conspicuous, but can readily be photographed. On the terminator they are at certain seasons easily seen. In the opposition of 1894, many were recorded at Flagstaff. The projection on the left-hand side of Fig. 3 is due to cloud. Only three clouds are on record which could be identified upon two successive nights. These all were discovered at Flagstaff, and were seen in the years 1894,* 1900,† and 1903.‡ They appeared in what would correspond to the late summer or autumn upon the planet, two within and one near the borders of the torrid zone, all within 60° of the Sinus Sabæus. They were all three at an altitude of about fifteen miles, and moved in a general northwesterly direction, with velocities of from 13 to 27 miles per hour. These altitudes are much greater than those of terrestrial clouds, while the velocities indicate a comparatively sluggish atmospheric circulation, which is what we should expect.

The nine photographs shown in Fig. 4 are the first ones ever taken showing detail upon Mars. Drawings and photographs of the planets are always turned so that south shall be at the top. The

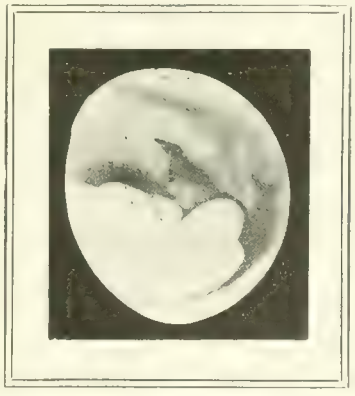


FIG. 3. REGION ABOUT SYRTIS MINOR, SHOWING SOME SHORT AND EXTREMELY NARROW CANALS.
A lake near center of one of the seas is also shown, just above center of the figure. From a drawing by the writer in 1894.

right-hand side is called east. The bright edge is called the "limb;" the dark edge, which is where the Sun is rising or setting, is called the "terminator."

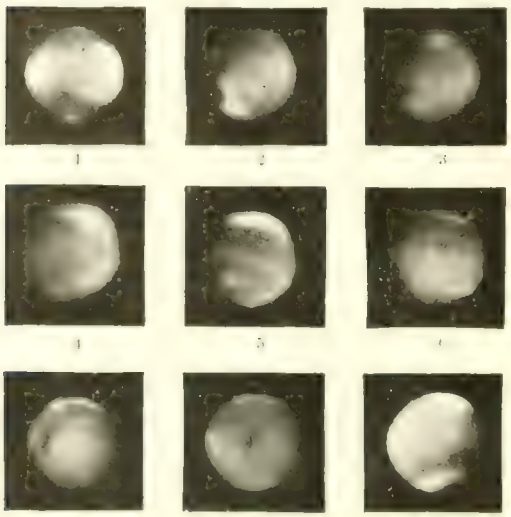
The first photograph shows the equa-

*Astro Physical Journal, 1895, I, 12; also "Mars," P. Lowell, 96.

†Proceedings, American Philosophical Society, No. 167, page 166.

‡Lowell Observatory Bulletin No. I.

equatorial cloud-band. The second shows the north polar cap. The third was taken the next day, and shows the formation during the twenty-four hours of a new south polar cap. The fourth was taken five days later, and shows the increase in size of this cap. The fifth photograph shows the cap well developed, also a faint equatorial cloud-belt, and below it one of those mysterious white spots which are never found far from the equator. Unlike the clouds, these spots do not change their position, but persist for long periods



of time. This one was still visible, although faint, at the end of six weeks. There are no mountains on Mars to collect clouds, save possibly a short range near the south pole. It does not seem likely that this spot was due either to ice or to clouds. It was located near the Trivium Charontis, in longitude 205°, latitude + 15°. A similar though less conspicuous white spot had been observed on the equator in longitude 300°, in 1892, at Arequipa, and in 1901 and 1903 at Flagstaff. The spot near the Trivium is visible only during the summer season on Mars, its first recorded equivalent date of visibility being June 2, and the last September 13. It is possibly due to vegetation. If so, it is perhaps appropriate that Schiaparelli should have designated this region under the name "Elysium."

The ninth photograph shows the decreasing size of the southern ice-cap, while a temporary belt of cloud surrounding the north pole is also shown. A study of photographs like these enables us to determine the duration of the cloudy and clear spells upon Mars. Continuous cloudy weather near the equator or tropics is very rare, but in the polar regions the clouds frequently last for weeks at a time. The intervening periods of clear weather are also of long duration.* The last three remaining photographs show permanent details upon the disc. The dark spot just above the middle of the seventh view is the Sinus Sabæus, from which Martian longitudes are reckoned. The dark spot on the two others is the Syrtis Major.

### Seas, Canals, and Lakes

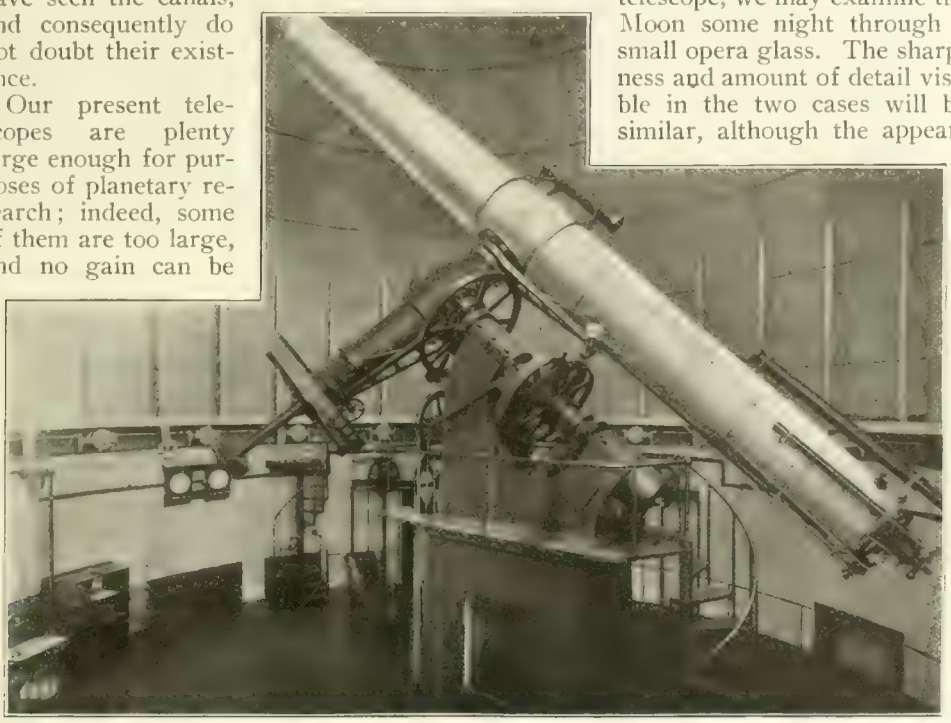
The first drawing ever made of a dark area or sea on Mars was of this same Syrtis Major, by Huygens, in 1659. The first map showing a canal and lake was constructed by Beer and Maedler in 1840. The canal was Dæmon; the lake, Lacus Phœnicis. The canals were first recorded in large numbers by Schiaparelli in 1877; the lakes, at the Harvard station in Arequipa in 1892, when forty of them were observed.

A large telescope is not necessary in order to see clearly the canals and lakes. One of eight or ten inches aperture is ample. The really important requisite however is a steady atmosphere, such as is found only in low latitudes, which gives what astronomers technically call "good seeing." This explains why it is that Mars cannot be studied to advantage at the large northern observatories, where, with the most superb optical equipment, little or nothing save the coarser detail can be seen upon its surface.

Doubt has recently been expressed in some of the foreign periodicals, even as to the existence of the canals. An astronomer who has never looked through a telescope, except in northern Europe or the

eastern United States, has no right to express any opinion on the subject, because he simply does not know what good seeing looks like, and his opinion is therefore valueless. He might as well express his views on electro-dynamics or physiology. The comparatively small number of astronomers who are familiar with good seeing, and have looked at Mars, have seen the canals, and consequently do not doubt their existence.

Our present telescopes are plenty large enough for purposes of planetary research; indeed, some of them are too large, and no gain can be secured by trying to improve them. In Cambridge an aperture of 6 inches will show everything on the Moon or Mars that can be seen with a 15-inch telescope. At Flagstaff, where the seeing is much better, Professor Lowell has stated that he often reduces his aperture from 24 to 16 inches in order to see more distinctly. What we must now do is to try to find places on the Earth where the seeing is better than anything yet discovered, and erect our future telescopes there. Then we can perhaps use still larger apertures to advantage. Heat or moisture have nothing whatever to do with the seeing; it is chiefly a question of latitude; and in low latitudes, such as Arequipa (—16°) and Flagstaff (+36°), the seeing is often very good indeed. The reason of this is that these places are far removed from the great cyclonic disturbances which affect our atmosphere in the temperate zones. At these places, the canals of Mars are perfectly distinct. To understand how the planet appears there through a large telescope, we may examine the Moon some night through a small opera glass. The sharpness and amount of detail visible in the two cases will be similar, although the appearance of the two bodies is quite unlike.



FAMOUS 26-INCH REFRACTOR AT THE U. S. NAVAL OBSERVATORY, WASHINGTON, D. C.
With this instrument the moons of Mars were discovered.

In former times the red color of the planet was supposed to be due to its atmosphere. Later it was seen that this was impossible. The dark spots on its surface were next thought to be water, and were called seas; while the bright red areas were supposed to be due to vegetation, which it was imagined must be of that color upon Mars. Later it was suggested that the so-called seas and canals were the real vegetation, the red areas being desert regions.* This view was strongly confirmed by the Arequipa observations of 1892, and the Flagstaff ob-

*Science, 1888, XII, 8; Astronomy and Astro-Physics, 1892, XI, 650.

LICK OBSERVATORY, MOUNT HAMILTON, CALIFORNIA

servations of 1894, and has since been generally adopted, although the old names, for the sake of their convenience, are still retained.

One out of several difficulties in supposing that the seas and canals are due to water, is that many of the canals cross the seas, which it is difficult to explain on that hypothesis (see Figs. 5 and 12). Some of the lakes on the planet, also, are located in the seas. The latter are found to be a vivid green in what corresponds to the springtime of Mars. Afterwards they turn grey; and still later those of them near the poles become yellow. They are then distinguished only with difficulty from the soil of the desert regions of the planet. In a recent observation made at this season by Lowell at Flagstaff, the Mare Erythræum was found to have turned a chocolate brown, a color which on the Earth we should associate with fertility. The writer has seen the same color exhibited at the time of the drying up of the temporary south polar ocean. The canals are usually too narrow to have any appreciable color, although in the case of the broader ones their color is thought sometimes to resemble that of the seas. Sometimes it is described by both Schiaparelli and Lowell as brown.

Their breadth is very uncertain; some observers like Douglass draw them very wide (see Fig. 5); others like Lowell, from whose drawing Fig. 6 is copied, extremely narrow. The writer gives them an intermediate breadth (see Fig. 11). Occasionally, with conditions favorable to the best seeing, short and extremely narrow canals have been seen by the writer (Fig. 3); but the long canals never appear to him as narrow as they are drawn by Lowell.

Recently Mr. Lampland at Flagstaff has succeeded in photographing some of the canals. At first it was supposed that these photographs would serve to convince the doubters of their existence; but it was soon found that those who doubted the canals were also unable to see them on the photographs, so that the

photographic argument seemed to have a minus value. Photographically the canals are extremely difficult objects, and

*The Observatory* the past year. Fig. 7 is a drawing by the writer, based chiefly on the third, but partly on the first photo-

LICK TELESCOPE, LICK OBSERVATORY, MOUNT HAMILTON, CALIFORNIA
Diameter of objective, 36 inches. Second in size only to the 40-inch Yerkes refractor of the University of Chicago, at Yerkes Observatory, Williams Bay, Wisconsin.

it does not surprise the writer that those unused to astronomical photographs, could not make them out.

A drawing from the photographs was made by Mr. Wesley and published in

graph issued in Bulletin No. 21 of the Lowell Observatory. The other photographs were also consulted, and no marking was considered assured which did not appear upon at least one of the others.

[illegible] photographs were taken about an hour after the drawing by Professor Lowell (Fig. 6) was made. A comparison of the two shows very clearly a tendency on his part to draw the detail too small, in comparison with the diameter of the disc.

[illegible] of the canals discussed, which Lowell states are visible on the photograph.

[illegible] thræum, Mare Icarium, and Syrtis Major—are all obvious on the originals from which Fig. 7 was sketched. The canals Nilosyrtis, Casius, and Pyramus are also perfectly clear, but, it will be noticed, do not appear on the photograph as canals at all, but as broad areas. Regarding the last two, this is true also of Lowell's drawing. His drawing of the first is certainly too narrow, as proved by the photograph. Of the remaining canals described by him—which come down as narrow lines in the photograph—Thoth, Astaborus, and Protonilus are fairly clear. Vexillum, Pierius, and Ismenius Lacus are more difficult, but apparently shown.

As a photographic triumph, these results are well worthy of record; and when we consider how difficult it is to photograph fine detail that is not merely obvious but even conspicuous to the eye, the photographs bear strong testimony to the distinctness with which the canals must have been visible at Flagstaff on the day in question.

Intermediate between the doubters and Professor Lowell's immediate following, there is a large class of persons who deny some of the fainter canals, and who doubt the uniformity of structure of the others. They say his canals are too regular, too narrow, and too straight—that if they were better seen they would be found to be made up of short broken lines of varying width, and perhaps, in places, of irregular spots. This proves to be the case with the lunar canals. With poor seeing and a low magnification, they seem to be perfectly smooth and straight, like the Martian ones; but with good seeing and a higher power, they are found to be quite irregular. Why should it not be true also on Mars? To this, Mr. Lowell replies that the lunar canals consist of dark markings lying along natural cracks, while the Martian canals are artificial. This may be so, but it would be hard to prove it.

Again, amidst numerous irregular and nearly invisible markings, the human eye, when straining for the faintest possible detail, naturally connects conspicuous objects by straight lines. Is it not possible therefore that many of these fainter canals are merely subjective effects?

The point of all this criticism is that the numerous long, straight lines give the planet a very artificial appearance. If the lines were more broken and irregular, they would look more like natural markings, more in fact like what we find upon the Moon. In short, the argument in favor of intelligent inhabitants would be greatly weakened.

### Duplication of the Canals

In 1882, Schiaparelli announced that the canals in Mars were sometimes double. One day a canal would be clearly seen, on the next day, or even a few hours later, there would be two in its place. Later the two would disappear, and again the canal would be single. Sometimes the single canal would coincide with one of the pair, but more frequently it would coincide with neither of them. When we consider that these double canals were often as much as 200 miles apart, these sudden changes seemed incredible.

When Lowell confirmed the duplication of the canals (see Fig. 9), many astronomers hesitated to accept it. In fact his observations even seemed to make it [illegible]

their separation with telescopes of different apertures, and succeeded in seeing the duplication when both by theory and observation it should have been invisible. Moreover, with a few exceptions, the only drawings he published showing the double canals were made by himself; and these exceptions were mostly made by Douglass, who, in the published text, expressed grave doubts as to the objective reality of the duplication. It is true, several other observers using much smaller telescopes claimed to see it; but it always happened to be just at the limit of visibility of their telescopes, no matter what the size of their instruments chanced to be. One of the most skilful of these observers, M. Antoniadi, later published his doubts as to the genuineness of what he had seen. On the other hand, most of the observers who used large telescopes always saw the canals single. Naturally the astronomers were not convinced.

Now further observations have been made, and new facts brought to light that partially explain this singular phenomenon. According to Professor Lowell, only about one-quarter of all the canals are ever seen to be double, and they are probably double all the time.* It is only when they are very faint that they appear single, and their faintness is apparently the reason that the duplication does not then show. This is due to the fact that under these circumstances one canal is somewhat fainter than the other, and so escapes detection. According to his views, the single canal always coincides in position with one of the two components of the double.

The double canals usually appear, he says, as a broad, hazy band; it is only by glimpses that the duplication is seen. There is nothing improbable in the idea that one-quarter of the canals should be permanently broad and the rest permanently narrow. The only question is, Is it likely that either the middle of these canals should fade out, leaving the sides dark; or that the sides should darken, leaving the middle bright?

It is a fact that some of the seas, as the season progresses, will fade out across the middle in places, leaving the rest dark, and thus present on a comparatively large scale a phenomenon similar to that claimed for the double canals. This same effect occurs upon the floor of the lunar crater Eratosthenes, forming two widely diverging canals. A long, double canal is also found upon the rim of this crater, but this is clearly due to the presence of two long, parallel cracks. A similar chance occurrence might occasionally be found upon Mars; but it seems to the writer in the light of the facts, and especially of the opinions of Messrs. Douglass and Antoniadi, that the case for a systematic duplication will not be proved until more well known observ

Fig. 7. Markings in the Sea of Cl[illegible] Mar[illegible]
Drawn by Wright, 12½ in. tel. Graph. Chem. at Flagstaff

ers, favorably situated and circumstanced, have recorded it.

### Seasonal Changes

Perhaps Lowell's most interesting recent investigation is on what he calls the Cartouches of the Canals—that is, their variable visibility dependent on the Martian seasons.* He finds that soon after the beginning of the melting of the northern ice-cap, the canals begin to develop in the north polar regions. These are immediately followed by the canals in the north temperate zone. A few weeks later, those in the torrid zone develop; and still later, those in the south temperate. The process of development, therefore, is carried on across the equator. This is most naturally explained by the growth of vegetation following the annual transference of water from pole

*Lowell Observatory Bulletin No. 12.

*Lowell Observatory Bulletin No. 12.

to pole. The speed of transfer he finds is at the rate of two miles per hour.

The striking difference between Mars and our planet is that in our equatorial regions, where we have plenty of water, there is continued fertility throughout the year. On Mars the vegetation must wait until the water reaches it semi-annually

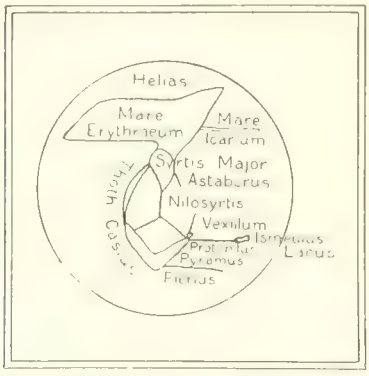



Fig. 8. Key Map Giving Names of Canals and Other Features

from the poles. There are accordingly two fertile and two barren seasons.

Professor Lowell concludes that the water is transferred artificially from pole to pole. In this we can hardly follow him, since with the rare atmosphere, and accordingly rapid evaporation and condensation upon Mars, the aqueous vapor would necessarily flow across the planet's surface of itself, being alternately condensed at each pole by the winter's cold.

A curious feature of the canals and other markings is that they do not always present the same appearance at the same equivalent time in successive Martian years. Thus, a certain marking called by Schiaparelli "Lacus Mœris" could not be found at all at Arequipa in 1892. After an interval of thirteen years since it had last been seen, it reappeared with perfect distinctness in 1903, and was observed by Lowell.* A very marked change in the Deucalionis Regio, observed in 1892 in connection with the melting of the ice-cap, did not take place again at the same equivalent season in 1894; nor has it been observed since. A certain canal observed by Schiaparelli was not found at all by Lowell, another one having replaced it. This latter only recently disappeared, Schiaparelli's original canal having taken its place.

*Lowell Observatory Bulletin No. 8.

### Is the Planet Inhabited by Intelligent Beings?

There is little doubt now that Mars possesses vegetable, and perhaps animal life; but the question that interests humanity is, Are there intelligent beings there? The only important argument in favor of their existence is the presence of the canals. These canals are so long and narrow, straight and uniform, that they look artificial. If they are artificial, it is certain that their constructors possess a knowledge of spherical trigonometry, and considerable skill in the mechanical construction of surveying instruments, implying greater intelligence than that possessed by our ancestors a thousand years ago. It is doubtful if our progenitors in the year 900 A. D. could have built a perfectly straight road three thousand miles long, directed to a definite point, even if it had been across level country.

But is the evidence sufficient as yet to warrant us in pronouncing in favor of

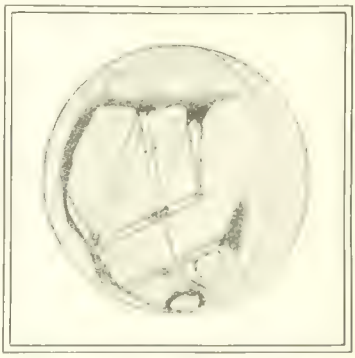


Fig. 9. Delicate Canals, Drawn by Professor Lowell.

Opposition of 1903. Sinus Sabæus is near top of disc. Syrtis Major on left.

such intelligent beings? Doubtless the temptation to do so is very strong, but that should not influence our judgment. It is a general principle of science that when two explanations of a phenomenon are possible, we should, other things being equal, choose the simpler. The maps of Mars (Fig. 10) look very arti-

ficial; but we must remember that they are composites of many drawings, such as are given in this article. All the canals shown on the maps are not seen at once; on the contrary, only a very few of them are visible on the same night. It seems to the writer that the arguments both for and against intelligent inhabitants have been materially strengthened during the more elevated areas as to flow in invisible channels to the larger canals, causing the vegetation there to develop, and thus become visible. A good deal of the moisture would sink into the soil, but this would the next day be evaporated by the Sun's heat, and continue on its course to the winter pole. This explanation, of course, does not necessarily involve the

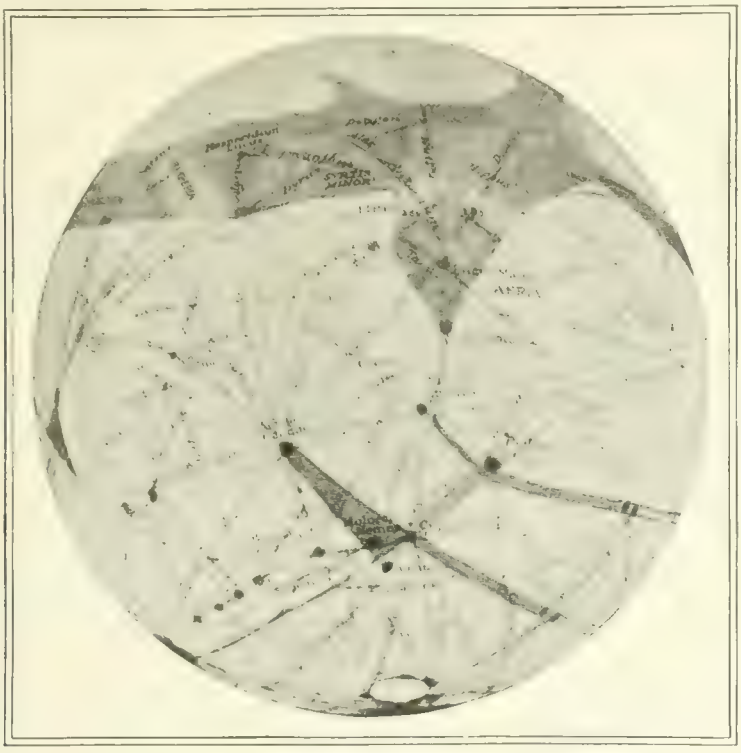


FIG. 10. MAP OF MARS IN 1903, BY PROFESSOR LOWELL.
Syrtis Major is at the top

past few years. It does not seem to him, however, that on either side are they conclusive. The reader must therefore choose for himself between them.

Let us suppose that there are intelligent inhabitants. One can imagine, in the seasonal transfer of the water across the equator, that a portion of the moisture, condensed from the air each night as a heavy dew, is deposited on the ground and perhaps on sparsely growing and therefore invisible vegetation, in the desert regions. From that rare atmosphere, consisting largely of aqueous vapor, so much may be condensed in the existence of intelligent inhabitants; but without them the canals would almost certainly in the course of time lose their straightness and artificial aspect.

The other explanation of the canals is that they are due to the same causes that produce those on the Moon. As seen through the telescope they look exactly like them, save that the Martian canals are much longer and somewhat wider. The lunar canals seldom exceed ten miles in length. They radiate from small lakes and join large seas precisely like the Martian areas, and are equally straight and artificial looking in appear-

ance. They wax and wane with the seasons in the same way. The Moon is so near that we can study them to advantage. The foundations of the lakes are minute craterlets; of the canals, fine cracks. As the season progresses, dark areas form about them and later fade out.

yards in width, by thirty in length. The terrestrial and lunar canals are certainly produced without intelligent assistance.

In conclusion, we may say that while we have not as yet sufficient information to settle this question definitely, information is slowly accumulating, largely

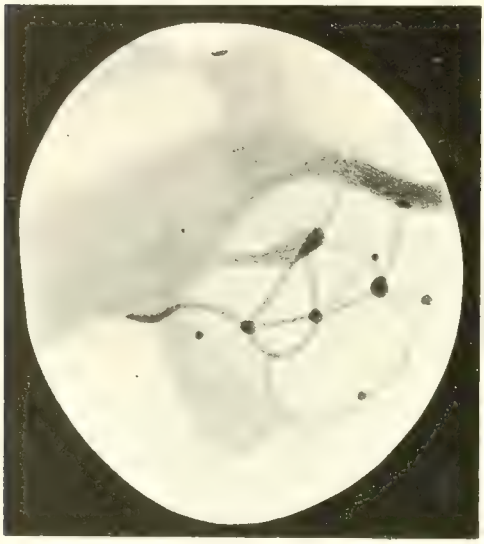


Fig. 11

Fig. 12.

HOW MARS LOOKS WHEN SEEN UNDER THE BEST POSSIBLE CONDITIONS

From drawings made by Prof. W. H. Pickering at Lowell Observatory, Flagstaff, Arizona, during last favorable opposition of planet in 1894. Scale, 1 to 100,000,000, or 1,600 miles to 1 inch. Fig. 11 shows canals and lakes about Solis Lacus; Fig. 12, canals crossing seas south of Syrtis Major. Flattening of the terminator or dark edge of the planet, over seas, is also shown in Fig. 11. Both figures show light shading in lower part of disc, which precedes formation of canals.

The explanation offered is that moisture is given out by the cracks, which is later absorbed. This moisture nourishes the vegetation to which the darkening is due. Exactly similar cracks, causing similar vegetational canals, are found in Hawaii. One characteristic canal was estimated by the writer at two or three

owing to Professor Lowell's indefatigable industry, which will doubtless decide it in time. His observatory is the only one at present specially devoted to securing an answer to it, and it seems almost a pity that some other favorably located observatory should not devote some of its time to the same object.

# Wireless Telegraph

## By Don Marquis

*Dead priests that have sung when the world was young at Mercury's temple-place,*
*Your myth, it was true. It is born anew in the death of time and space!*

MORE swift, more fleet, than the sun-stained feet of the Dawns that trample the night--
More fleet, more swift, than the gleams that lift in the wake of a wild star's flight—
Through the unpathed deeps of a sea that sweeps unplumbed, unsailed, unknown,
Where the forces untamed, unseen, unnamed, have ruled from the First, alone,
Now the Ghosts of Thought, with a message caught from the tales of the dreaming past,
Unheard, unseen, with nor sound nor sheen, speed through the ultimate vast.

ALL battered and lamed and shattered and maimed the mail-ship crawls into port,
And the belted tire and the volted wire are the toys of the whirlwind's sport;

AND the gray sea's teeth in the depths beneath, where the coiled, green serpents play,
Are crumbling, crunching, mumbling, munching, at the cable lengths alway—
But now they may howl, the storms, and growl, at the work of the lineman's hands,
But gone is their pride with the boast of the tide that bit at the deep-sea strands.

FOR a sentience thrills through the bastioned hills that has neither voice nor form,
Nor recks of the might of the Chaos-sprite that lashes the earth with his storm;
Bitted and bridled and shackled and girdled and bound with a linkless chain,
The brute powers cower at the god-like power that dwells in a human brain;
Man has stolen the wings of the deathless Things that range where the spirit is lord,
He is leagued anew with the Silence through the strands of a strandless cord.

MAN'S feet are clay and they halt and stay with the graveyard worms and clods,
But his plumed thought flings to the wind its wings in the haunts of the careless gods—
For those old gods live, and they weave and give new meanings to old myth;
And blossoms and gleams of the world-old dreams flower fresh from the truth at their pith—

SO the tales that twine round the ruined shrine where Hermes' priests have sung,
They were true, they are true, they are born anew in the speech of a younger tongue.

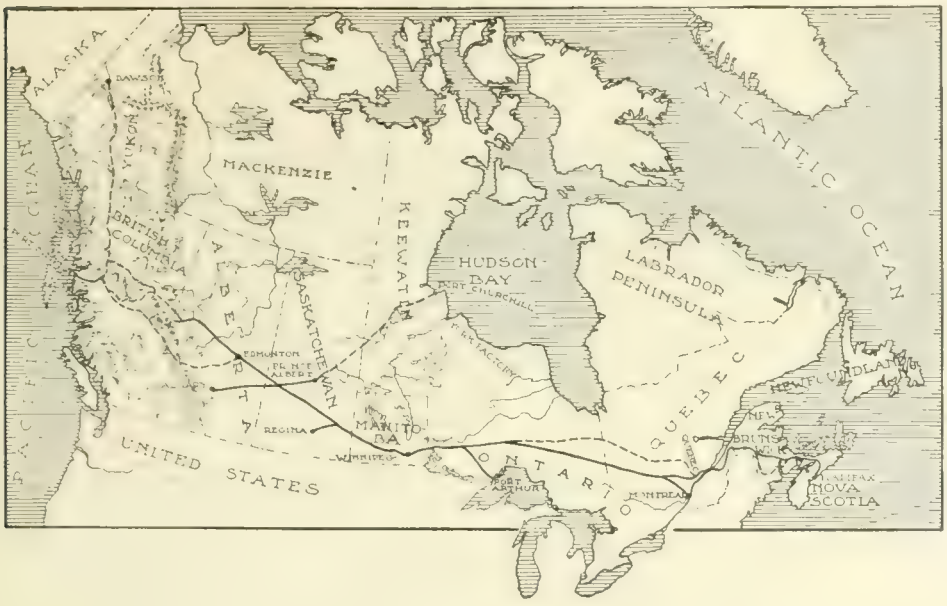
*Reprinted, by permission, from American Magazine.*

RAPIDS AT SECOND PORTAGE ON SLAVE RIVER

Slave river joins Lake Athabaska with Great Slave lake, the waters of which find their outlet through the Mackenzie river to the Arctic Ocean.

MAP SHOWING APPROXIMATE ROUTE OF GRAND TRUNK PACIFIC RAILWAY AND CONNECTIONS.

The eastern terminus will be at Moncton, N. B., with connections to Halifax, N. S., and St John, N. B. The western terminus will be at Fort Simpson, on the Pacific coast of British Columbia.




# On the World's Last Frontier

## By Richard A. Haste

FOR two hundred years the dead hand of a German prince kept its clutch on nearly half the continent of North America.

It was in 1670 that King Charles of England granted to Prince Rupert of the Palatine—who had fought dashingly on land and sea against the Cromwellian Commonwealth—absolute and despotic power and sovereignty over all the vast territory watered by streams which eventually drained into Hudson's Bay. The title ran to the gay prince and seventeen other nobles and gentlemen organized in the stately style of those gallant days as "The Governor and Company of Adventurers of England Trading into Hudson's Bay."

When the Hudson's Bay Company—for so it was briefly called—took possession of its realm, all of Canada was a vast unknown. From the start the policy of Prince Rupert and his successors in the governor's chair was one of secrecy and silence. Sitting snug in their warm offices in London, the members of the company grew fat and proud and vastly opulent during the slow passage of two centuries; while oversea their grim-faced Scotch factors, scattered about the "great lone land" in solitary forts and "factories," traded rum and firearms and trinkets to the Indians for the rich furs of ermine and beaver and silver fox. Once a year these furs went home to London in the holds of the company's steamers, and were sold at auction to the tremendous profit of the company's strong box.

Until 1869 the Hudson's Bay Company held power of life and death over the whole country stretching from Labrador on the east to the foothills of the Rockies towards the setting sun. It was, of course, vastly to its interest that rival

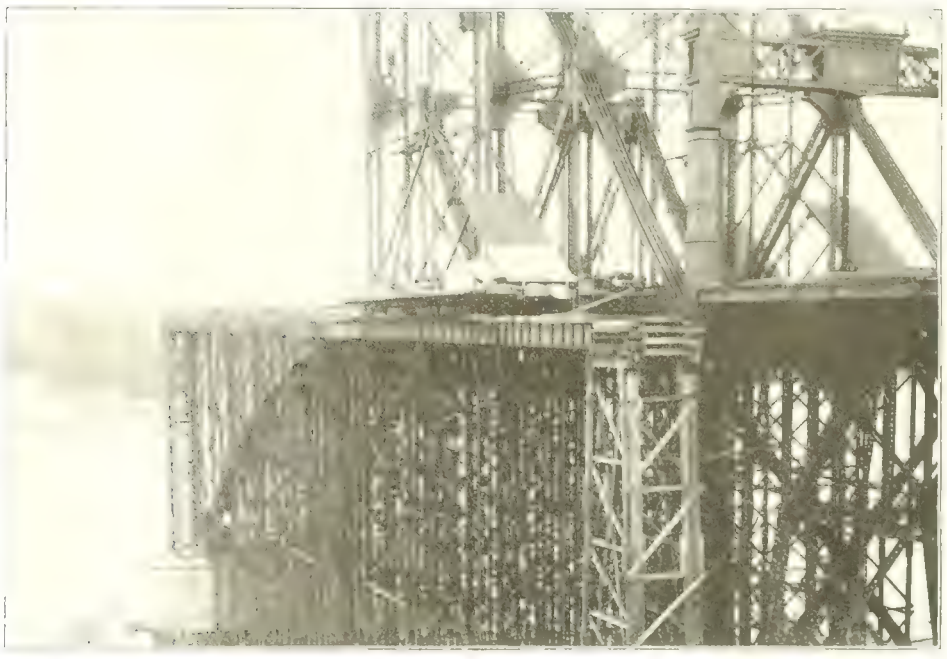
VIEW OF GREAT CANTILEVER BRIDGE UNDER CONSTRUCTION OVER THE ST. LAWRENCE RIVER A FEW MILES ABOVE QUEBEC

The end of the steel arm of the new Quebec bridge is shown at the left.

tender should be kept out of its great forests. And when daring men did venture to pass its boundaries, their dead bodies were likely to be found months later lying beside the trails as mute warnings to those who might follow after.

So there grew up a tradition that beyond the cities built along the St. Lawrence, Canada was chiefly an ice-bound, desert land, full of great perils, and offering nothing that might tempt the most adventuresome of settlers. Until 1869 the invisible wall raised by the traders of the Hudson's Bay Company against the rising tide of civilization, held with hardly a break. Mystery and awe, silence and terror brooded over the land.

But in that year the British Government bought back the charter rights of the Hudson's Bay Company. The price was $1,500,000 in cash, and the grant, in perpetuity, of one-twentieth of all the



NEW FERRY OVER ST. LAWRENCE ABOVE QUEBEC

land covered by its original grants. In every square mile surveyed since, the Hudson's Bay Company has selected some of the choicest lands, so that it still stands as the greatest private landowner and one of the richest corporations on the continent.

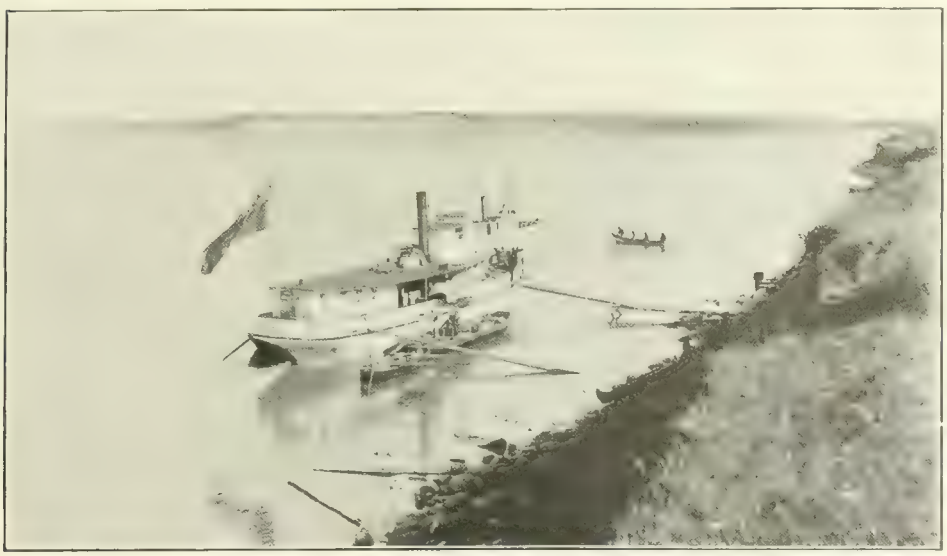
But with the passing of the great company as sovereign lord of the land, light began to break over western Canada. Prospectors and settlers, miners and farmers, and individual adventurers pushed their way into every corner of the long-sealed empire. Under their knowledge the old traditions crumbled.

Canada awakened to a consciousness of its own strength and of its own resources. It became known that the vast territory south and west of Hudson's Bay was not an ice-bound desert, but rather a garden spot of fertility, specially fitted by nature for the growing of vast crops of hard winter wheat. Almost inexhaustible forests of valuable timber were discovered. The richest silver mines in the world were located in northern Ontario and Quebec. A whole new world of opportunity lay open to conquest and exploitation.

But one factor was still lacking. There was no means of transportation. So vast is the country that all the New England States, with New York and Pennsylvania added, might easily be lost in any one of several Canadian provinces; and the only way of land travel was by dog-sled in winter and by Red river ox-carts or pony-back in the warmer season. After a while the first transcontinental railroad crept westward, but that ran so far to the south as to tap only the edge of the new empire. Far to the north lay millions of acres which would become wheat fields as soon as some way of hauling the crops to market was provided.

RAMPARTS ON THE MACKENZIE RIVER

Meanwhile, from the south, American farmers, attracted by the offer of rich wheat lands for little more than the taking, came over the border in increasing



HUDSON'S BAY COMPANY STEAMER AT JUNCTION OF MACKENZIE AND LIARD RIVERS.
A little south of the latitude of Dawson City. The Mackenzie river (including the Slave and Athabaska rivers) is over 2,000 miles long.

CHARLES M. HAYS.

General Manager Grand Trunk Railway System, and President Grand Trunk Pacific Railway.

Born in Rock Island, Ill., in 1856. Was formerly General Manager of the Wabash System, President of the Southern Pacific Railway, and prominently connected with many other American railroad lines.

numbers and became subjects of His Britannic Majesty. In 1905, no less than 50,000 husbandmen from the Dakotas, Minnesota, and other Western States, settled in Alberta, Manitoba, and Saskatchewan. This year it seems certain that the number of emigrants will increase to 75,000.

And it would seem that their faith is fully justified. Beginning at the Atlantic ports of Halifax and St. John, and running across the continent through the heart of the mineral, forest, and wheat country, a great new railroad system is being surveyed, and is in part already building, with Pacific terminus at Port Simpson. The new system is the Grand Trunk Pacific, with a main line 3,600 miles in length —easily the greatest railroad enterprise of the twentieth century.

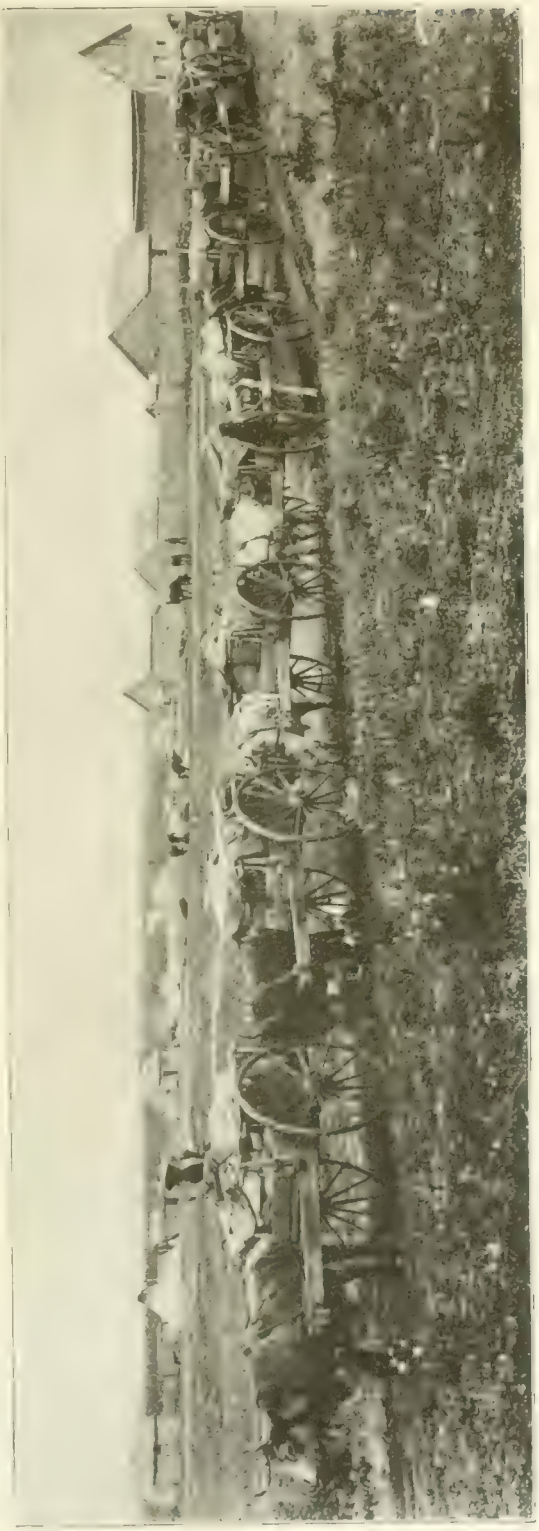
One of the main branches—already surveyed—runs northwest from Hazelton in the Rocky Mountains to the city of Dawson, of Klondike fame, in the Yukon. And of this line, Pres. Charles M. Hays of the Grand Trunk Pacific, says:

"Speaking of the proposition made by a syndicate of Russian and American capitalists to tunnel Bering Strait for the use of an intercontinental line through Alaska and upper Siberia, our Dawson branch will form the necessary connecting link.

Doubtless, before the middle of the century is reached, it will be possible to travel by rail, without change, from New York to Berlin or any other of the capitals of continental Europe. But long before then the Grand Trunk Pacific will do its work of opening up the old land of Prince Rupert to civilization and prosperity.

### Branch Lines

Hardly less important than the main lines of the Grand Trunk Pacific, are the branches—the feeders that are to be built as a part of this gigantic system.



HUDSON'S BAY COMPANY TRANSPORT LOADED WITH FURS.
View taken at Fort Smith, on the Slave River.

TOWN OF PRINCE ALBERT, ON NORTH BRANCH OF SASKATCHEWAN RIVER
Located a short distance above the junction with the South Saskatchewan. The Saskatchewan, rising in the Rockies, is navigable almost throughout its entire length of 1,500 miles. It flows into Lake Winnipeg, and thence, through the Nelson River, into Hudson's Bay.

From points on the main line in Quebec and Ontario, branches will be built to Montreal and North Bay to connect with the parent system—the Grand Trunk. Another and most important branch is building to Port Arthur and Fort William, the head of navigation on Lake Superior. This lake port will for a number of years be the eastern terminus of the Prairie Division of the system, affording an outlet for the grain and other agricultural products of the Northwest. The Calgary-Prince Albert branch crosses the main line west of Battleford. There is little doubt about this branch being the initial part of a line to York Factory on Hudson's Bay, opening up a new and more direct outlet to Europe for the products of the Northwest. Other branch lines also will be built as rapidly as the business of the country warrants. The branch lines already projected and under construction foot up nearly two thousand miles.

The company's policy will be an aggressive one in connection with entering new territory; and in addition to the main line and branches named in the charter, application is now before Parliament for the incorporation of the Grand Trunk Pacific Branch Lines Company, under which branch lines will be extended in all directions where the traffic possibilities are promising.

### A Bit of History

With Confederation and the subsequent completion of the Canadian Pacific Railway, connecting the eastern provinces with British Columbia and opening up the vast but then unknown agricultural empire between, the national life of Canada began. In the building of the Canadian Pacific, the Government aided by stupendous land grants. The subsequent development of the Northwest proved the wisdom of the policy. The Canadian Pacific soon became the greatest railway corporation on the continent. But there was another railway that covered eastern Canada and with branch lines reached across Michigan to Chicago. As in all railway situations, there was a tacit agreement for each to keep out of the other's territory. The Northwest was claimed by the Canadian Pacific by right of discovery. But the unprecedent-

CANADIAN NORTHERN RAILROAD ELEVATORS, PORT ARTHUR, ONTARIO.

ed development of this great interior basin, and the possibilities of the unexplored regions north of the territory occupied by the Canadian Pacific, were magnets too strong to be resisted by any mortal railroad. The Grand Trunk management, at the head of which was Chas. M. Hays, determined to get in while yet there was time to secure a footing on the "ground floor." This meant the building of another transcontinental line —and the Government has no more land to give away.

In 1903 a rumor somehow got afloat that the Grand Trunk was contemplating a line from North Bay to the Pacific. General Manager Hays and a party of capitalists made a journey through the West. The public pulse was felt, and was found to beat strongly in favor of the project whatever it might be. The Government was appealed to, and the result was a contract by which the Government joined with the Grand Trunk Railway Company of Canada to build and finance a line from Moncton to Port Simpson, all on Canadian soil, and to turn it over to the Grand Trunk Pacific Railway Company to operate.

By the terms of this agreement between the Government and the Grand Trunk Pacific Railway, the Government undertakes to build the line from the eastern terminus at Moncton to Winnipeg, a distance of 1,800 miles, and to lease it to the Grand Trunk Pacific Railway for a term of 50 years. At the expiration of this period, the Company has the option of another similar term, providing the Government does not elect to operate the road. In that case, traffic arrangements are to be granted the Company over the Eastern Division, on such terms as may be mutually agreed upon.

The western half of the line is to be built by the Grand Trunk Pacific Company, the Government guaranteeing the construction bonds, both principal and interest, to the amount of $13,000 per mile through the Prairie Division, a distance of about 1,100 miles. Through the Mountain Division, a distance of about 700 miles, the Government guarantees bonds to the amount of three-fourths of the cost of construction. The construction bonds in excess of the government guarantee are secured by the guarantee of the Grand Trunk Company.

The Government is to receive as rental on the Eastern Division a yearly amount equal to 3 per cent of the cost of construction.

The building of the government section is to be under the control of a railroad commission of three. To guard against extravagance or possible political

CANADIAN PACIFIC RAILWAY STATION AT EDMONTON, ALBERTA.

LOGGING TEAMS AT ONE OF THE MANY LOGGING CAMPS NEAR PRINCE ALBERT

jobbery, the Grand Trunk Pacific has the right to bid on all construction work, and all specifications must be submitted to the engineers of the Grand Trunk Pacific before being submitted to bidders. This arrangement insures to the Government a good piece of road, and gives the Grand Trunk Pacific a check on the cost of construction.

How they Travel in the Far Northwest
The half-breed Indian runner behind keeps pace with the dog team for hours at a time without resting.

The branch lines are to be constructed by the Grand Trunk Pacific without aid from the Dominion Government. Subsidies, however, are obtained from provincial and municipal authorities. The Lake Superior branch, now under construction, receives a bonus of $2,000 and 6,000 acres of land per mile, from the Province of Ontario, while from the town of Fort William it receives a cash bonus of $300,000 for terminals.

### Progress of the Work

Although less than two years have passed since this enterprise was launched, already the surveys have been largely completed, and more than a thousand miles placed under contract for construction. The line from Winnipeg to Port Arthur, consisting of a small portion of the main line to be built by the Government, and the Lake Superior branch, together with the main line from Winnipeg to Edmonton, will be completed before September, 1907.

It is estimated that it will take seven years from 1904 to complete the line from Moncton to Port Simpson, and until that time the traffic of the Northwest will

JUST BACK FROM A FUR-TRADING EXPEDITION.
Dog-sleds loaded with furs at old Fort Garry, site of Winnipeg.

FORT McPHERSON, MOST NORTHERLY POST OF THE HUDSON'S BAY COMPANY.
Near the mouth of the Mackenzie River. This point is located near the extreme northwestern corner of the great, unorganized District of Mackenzie, not far from the boundary of the Yukon District.

STREET SCENE IN WINNIPEG, MANITOBA.
Main Street, corner of Portage. Winnipeg is the capital of the Province, and the chief commercial city of the "Fertile Belt."

go by way of Port Arthur, by boat to some Great Lake terminus of the Grand Trunk Railway, where it will be received by that road for eastern points.

### Character of the Territory

We of the United States have not fully awakened to the importance of our northern neighbor. We do not realize that the valley of the Saskatchewan is scarcely inferior in productive power to that of the Mississippi. Neither do we realize that the climate of Western Canada is much like that of our West—that the mean annual temperature at Edmonton is but one degree colder than that at St. Paul. This whole domain from Winnipeg to the

OLD HUDSON'S BAY COMPANY FACTOR HOUSE AT EDMONTON, ALBERTA.
Building about 100 years old

Peace river is teeming with vitality, and most of it is as fair as the garden of the Lord.

Those who have gone from Winnipeg to North Bay over the Canadian Pacific will remember the barren, almost desolate appearance of the country through which the road passes. But one must not always judge a country from the window of a car. In this case the Canadian Pacific line hugs the north shore of Lake Superior, and no doubt traverses one of the roughest parts of the continent. The country may be rich in minerals—it no doubt is—but it is a tough-looking proposition to the uninitiated stranger. North of this height of land—where the waters flow to Hudson's Bay—you find a different country. It is through this region, a hundred miles or more north of Lake Superior, that the main line of the Grand

HOUSE OF RUSSIAN PEASANT IN ALBERTA.

Trunk Pacific extends. Much of this country is adapted to agriculture. The surface is covered with timber, and the soil is good. From the vicinity of longitude 74 degrees to the boundary line between Quebec and Ontario at the eastern end of Lake Abitibi, the country is set with numerous lakes, the land bearing a growth of timber, with spruce, birch, cypress, poplar, tamarack, and cedar predominating. From Lake Abitibi west to about 84 degrees, the country is well adapted to farming, the soil being a rich clay, and the timber a light stand of birch, poplar, and balm of gilead.

The climate, after you pass the divide and enter upon the James Bay slope, becomes much milder, and compares very favorably with that of the older portions of Canada. As to the mountain section through British Columbia, no richer mineral region is supposed to exist on the continent than will be here opened up.

From Moncton to Port Simpson, with the exception of less than two hundred miles west from Winnipeg, the entire line passes through an absolutely virgin

ONE OF EDMONTON'S PUBLIC SCHOOLS.

TRACKING ON THE ATHABASKA RIVER.

country—a country as rich as the richest in natural resources.

Development in the Mountain Division and along the Eastern Division will of necessity be slow: they are both mineral and timber propositions, and it takes time to remove timber and develop mines. But this is not true of the Prairie Division—the eleven hundred miles of open country between Winnipeg and the foothills of the Rockies. Settlement here is advancing faster than railroads can be built. For the last four years the plow, the reaper, and the thresher have preceded the locomotive. Go where you will over these prairies, you will find that the agricultural implement dealer and the Canadian banker has outfooted you. Hot on the trail of the surveyors, come these heralds of civilization. Before the sidetrack of the railroad is laid, the shack of the implement dealer and the little board shanty with the sign "Bank of Montreal" or "Bank of Canada" is there to greet you. These two, with the Mounted Police, are the Heralds of Empire on this last of the great American frontiers.

An idea of the agricultural possibilities of this central basin may be gathered from the estimated extent of the acreage suitable for the plow. Of course this is not accurate—it cannot be under present conditions—but a conservative estimate places the area fit for agricultural purposes at 200,000,000 acres. And I am of the opinion that this amount will be increased by one-half when the pressure of settlement has raised the price of land.

HUDSON'S BAY COMPANY STEAMER ON NORTH SASKATCHEWAN RIVER NEAR PRINCE ALBERT.

### How the New Project was Financed

The capital stock of the Grand Trunk Pacific Company is $45,000,000, of which $20,000,000 may be issued as preferred. The common stock is to be acquired by the Grand Trunk Company of Canada as a consideration for certain guarantees.

In the contract with the Government, the Company is to expend $20,000,000 in equipment. It is estimated that the Eastern Division, which the Government is to build, will cost $30,000 per mile—a total of $54,000,000. The estimate on the Prairie Division is $20,000 per mile

TRADING BOATS LEAVING ATHABASKA LANDING, ALBERTA.

From this point the Athabaska River, which rises in the Rockies near the headwaters of the North Saskatchewan, runs northward into Lake Athabaska.

(a liberal allowance), and the Mountain Division is estimated at $50,000 per mile, making a total of $57,000,000, and a grand total for construction of the main line of $111,000,000.

of $20,169,000, guaranteed by the Grand Trunk Company of Canada. A mortgage to secure a further issue of 4 per cents to the amount of $7,633,000, has been executed on the Lake Superior branch.

ONE OF THE SPECIMEN PRODUCTS OF THE CANADIAN NORTHWEST.

Silver fox skin valued at $1,500. Edmonton is one of the most important primary markets for furs on the continent

The Company has authorized and executed three per cent first-mortgage bonds on the Western Division to the amount of $68,040,000, guaranteed by the Canadian Government; also a mortgage on the same division securing an issue of 4 per cent bonds to the amount

Of these bond issues, $33,000,000 has been placed. Such was the confidence felt in the proposition by reason of the quasi-partnership between the Company and the Government, that the first issue of bonds offered was subscribed three times over.

Group of Dog-Ribbed Indians.
From Great Slave Lake.

### The Originating Mind

Who is the originator of this gigantic project, with its elaborate yet simple arrangement with the Government, is not officially announced. But it is understood that Charles M. Hays, General Manager of the Grand Trunk Railway Company and also President of the Grand Trunk Pacific Railway, is the guilty party. At least he has been found with the goods in his possession, and the burden is on him to prove an alibi.

Hays is an American—a Yankee, as they call him. He was born at Rock Island, Illinois, and as a boy got into the railroad business. He served in various capacities with the railroads of the West. He went from the Wabash to the Grand Trunk, where his personality and his methods soon turned that conservative institution upside down. The Grand Trunk had been run from London. When Hays took hold, it was run from Hays's office. The energy and consummate grasp of the situation that have been shown in the Grand Trunk Pacific project, seem to spell Charles M. Hays.

### Details of Construction

James J. Hill spent $750,000 in the preliminary surveys of the Great Northern Railway. It was cheaper to do this than to change the grades and straighten the line after it was built. The policy of the Grand Trunk Pacific is to secure the lowest possible grades and the most direct route across the continent. The grades on the Eastern Division will be kept down to 4 per cent (21 feet to the mile). In the Mountain Division, 14 per cent (53 feet to the mile) will be the maximum. This will be possible, as the passes selected have an extreme summit elevation of only 2,500 feet, as against 5,299 feet on the Canadian Pacific Railway, 5,202 feet on the Great Northern, and 5,567 feet on the Northern Pacific.

The route throughout will be unusually straight for such a railroad. There will be no swerving aside for this or that town which offers a bonus. From Winnipeg to Edmonton, but two points of importance—Portage la Prairie and

Russian Peasants (Galicians) in Alberta.

Group of Eskimo.
View taken at midnight

TYPICAL SCENE IN ALBERTA.
Horses and cattle range over these plains all winter, hundreds of miles north of the international boundary, and are found in good condition in the spring.

Saskatoon—are touched. The other ambitious towns, such as Brandon, Regina, Port Arthur, Prince Albert, and Calgary, must be content with branch lines.

Statistics are as a usual thing dry reading; but the following figures prepared by an engineer with a bent for such things, show up the magnitude of the enterprise as nothing else can.

Considering the main line alone—3,600 miles—with 3,000 ties to the mile, the construction will take 10,800,000 cross-ties. If these are produced entirely by hand, it will take 500 men working three years to get them out. If the steel rails were placed end to end, the line would cover 7,200 miles; and if the side tracks and the branch lines were included, the steel band would reach half way around the globe.

In every tie there are at least four spikes, making a total of 43,000,000. For every rail, two angle-bars are used and four bolts, four washers, and four burrs —a total of 2,534,400 angle-bars, and 5,068,800 each of bolts, washers, and burrs.

The estimates of locomotives is 500, at an average cost of $15,000—an expenditure of $7,500,000 for power. The average cost of passenger cars is $10,000. There will be 500 of these required—$5,000,000. The average cost of freight cars is $700, and it will require 30,000 to handle the traffic —another item of $21,000,000. The fencing of the right of way will cost $1,530,000. The average cost of a telegraph line is $200 per mile—another item of $720,000. The largest item in the telegraph estimate is the poles. It will take 118,000 poles.

RED-RIVER CART, PONY, AND DRIVER.

These will cost $3 each—a total of $356,400.

The number of persons required to operate the completed system—main lines only—will be about 20,000. Giving to each an average wage of $2 per day, it will require $14,600,000 a year for salaries alone.

Simpson by the Grand Trunk Pacific, it is 3,025 miles; from Port Simpson to Yokohama, it is 3,860 miles—a total of 9,517 miles. This is a saving of nearly 2,000 miles over the Suez route, and more than 1,000 miles shorter than by way of New York and San Francisco.

The new road will undoubtedly prove

TYPICAL VIEW IN THE IRON-MINING COUNTRY NORTH OF LAKE SUPERIOR.
Diamond drill at Atikokan Iron Range, 125 miles from Port Arthur, on Line of Canadian Northern Railway

### The World's Highway

The eastern ports of the Grand Trunk Pacific will be St. John and Halifax. These ports are connected with Moncton—the eastern terminus proper—by the Intercolonial Railroad, a government institution. These ports are open the year round. For six months of the year, ocean-going vessels will connect with the railroad at Quebec and Montreal. The Pacific port will be nearer the Far East by several hundred miles than Vancouver.

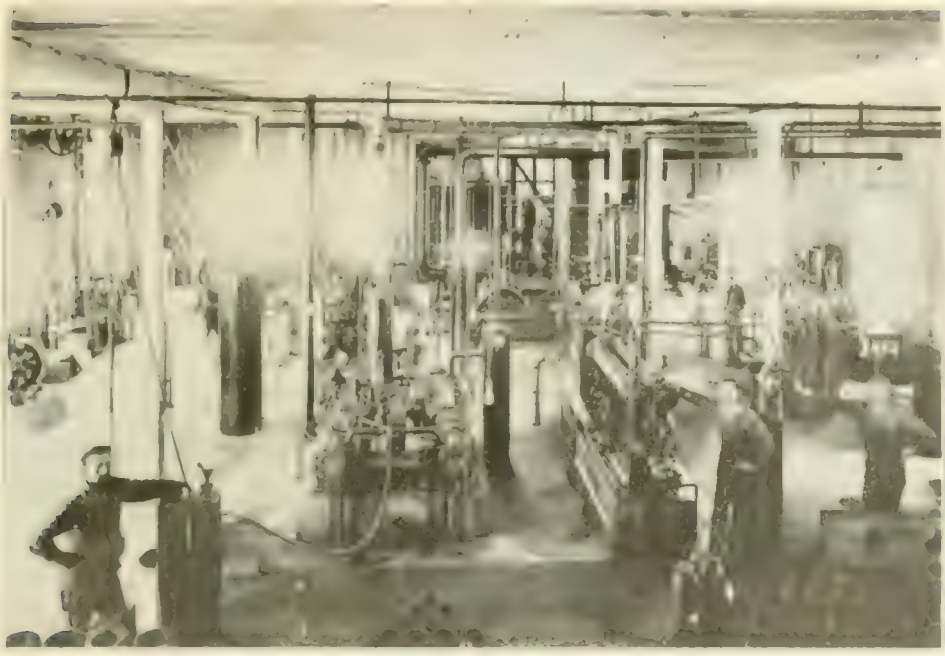
From Liverpool to Yokohoma by the Suez canal is 11,250 miles. Between the same points by way of Berlin, Moscow, and the Trans-Siberian Railroad, it is 9,650 miles. From Liverpool to Quebec it is 2,632 miles; from Quebec to Port

—as the Canadian Pacific has proved—a factor of incalculable importance in the development of a virile national life and sentiment in Canada. The Dominion is already claiming the twentieth century as its own, and the prediction of a population of eighty millions before the cycle is completed may not be born of overenthusiasm. Certainly there is room on this great continent for two great countries. The one to the south has had the advantage of an early start, and has developed an energy, a national impulse, an institutional system, a type of life, and a magnitude of attainment peculiarly its own. The future holds out substantially similar promise for the kindred community on the north. What their ultimate mutual relations will be, none can say.

But if not in political union, at least in amicable rivalry, both are joined in the common destiny of the West; and for an indefinite time these two young giants among nations will continue to afford to each other and to the world at large object-lessons which all may study with profit.

WHEN the conduct of men is designed to be influenced, PERSUASION, kind, unassuming persuasion, should ever be adopted. It is an old and true maxim "that a drop of honey catches more flies than a gallon of gall." So with men. If you would win a man to your cause, first convince him that you are his sincere friend. Therein is a drop of honey that catches his heart, which, say what he will, is the great highroad to his reason, and which, when once gained, you will find but little trouble in convincing his judgment of the justice of your cause, if indeed that cause really be a just one. On the contrary, assume to dictate to his judgment, or to command his action, or to mark him as one to be shunned and despised, and he will retreat within himself, close all the avenues to his head and his heart; and though your cause be naked truth itself, and though you throw it with more than herculean force and precision, you shall be no more able to pierce him than to penetrate the hard shell of a tortoise with a rye straw. Such is man, and so must he be understood by those who would lead him, even to his own best interests. ABRAHAM LINCOLN.

PLANT OF THE U. S. LIQUID AIR & OXYGEN COMPANY, LOS ANGELES, CAL.
Interior View.



# Canning California Breezes

## By Wilbur Bassett

CALIFORNIA air condensed into liquid state and packed for export, is the latest product of the Golden State to appear upon the market. It is now possible to eat California oranges which have never left California air in their long journey across the continent, and indeed they may be served at one's table with a sauce of the breezes which blow over their native groves.

A comprehensive plant for the manufacture of liquid air and of oxygen has been erected in the city of Los Angeles, which is the only plant in the country manufacturing these products on a commercial scale, with the exception of a New York plant whose output is confined to surgical and metallurgical uses. The plant will presently have a capacity of 450 gallons of liquid air or 50,000 cubic feet of oxygen per day of ten hours. With an unlimited supply of raw material and an output limited solely by the capacity of the compressor, there remains only the question of finding a market, and present indications point to a growing demand for these novel wares.

Situated in the heart of a warm, fruit-growing country, without natural ice, and separated from its chief markets by tremendous stretches of hot country, the question of refrigeration of fruit cars is one of the most important which the Californian has to consider. If, as is hoped, the product of the Los Angeles factory can be used as a successful substitute for manufactured ice, the market is at hand, and the new industry is ideally located. Fruit-growers, car-builders, merchants, shipping agents, and packers await with interest the extended trials which are now being instituted.

PLANT OF THE U. S. LIQUID AIR & OXYGEN COMPANY, LOS ANGELES, CAL.
Exterior View.

This question of refrigeration of ships and icing of cars has come to be one of the living issues of the past few months, through the spirited controversy arising over the alleged abuses of the private refrigerator-car system; and the details of the far-reaching and costly organization of these systems have been made known to an interested public. The importance of economical and effective refrigeration to the public welfare and the private pocketbook, has been illustrated by these discussions in the public print, and the problem has ceased to be one of special and technical interest.

Whether liquid air is the solution of one phase of the problem, the conservative investigator is not yet ready to answer; but the indications are persistently pointing that way, and so definite and probable are these indications of success, that packers, and operators of refrigerator-car lines, have entered into a contract with the Los Angeles manufacturers for the erection in Chicago of a still larger liquid-air plant, and are about to enter into experiments in its use upon an extended scale which will insure definite results in the near future. Meanwhile the use of liquid air in the arts and crafts and in medicine continues to increase the demand, to offer new applications for its use, and to extend a knowledge of its properties.

So little is as yet generally known of its nature and habits that it is only recently that the express and transportation companies have consented to transport it under any circumstances. It is now shipped daily to distant points, in tanks of galvanized sheeting, with no thought of danger.

The process of manufacture of liquid air and its suitability for purposes of refrigeration, are easily understood by the layman. It is a matter of common knowledge that the change of any substance from the gaseous to the liquid or the solid state is accompanied by a change of temperature; or, in other words, that the state of a substance, as to whether it is gas, solid, or liquid, depends upon its temperature. Thus water at a lower temperature becomes ice, and at a higher temperature steam. Ice occupies a slightly larger volume than the water from which it came, and steam a much larger volume, so that the volume and temperature both vary.

The first-hand way to reduce volume, whether of a bale of hay or a given gas, is by pressure, so that the process of reduction of a gas to a liquid is seen to consist in lowering its temperature and condensing it by pressure.

Early experimenters ignored the assistance to be gained by lowering the temperature, and strove to procure re-

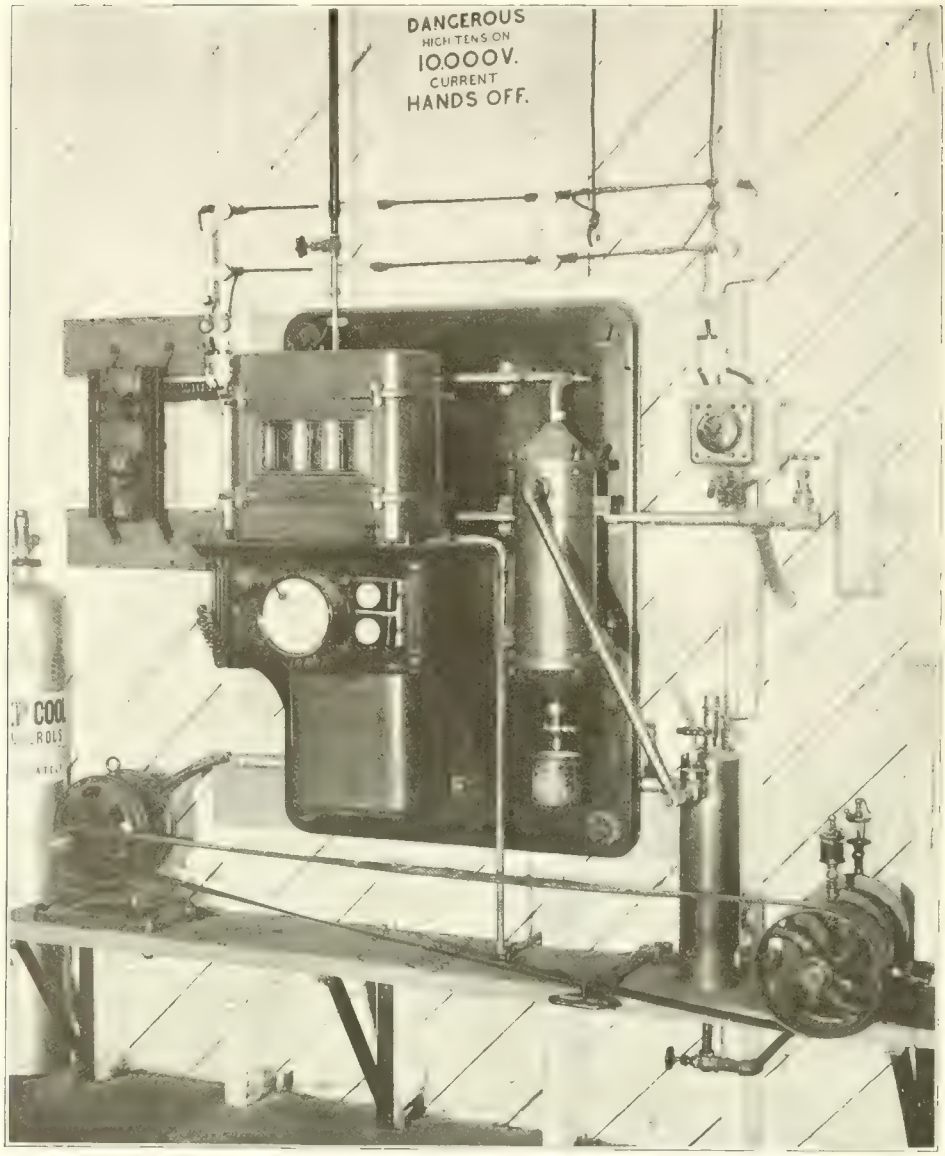
sults by pressure alone. It was presently found that pressure alone, without means of attaining and securing low temperatures, was insufficient. Every gas was found to have a certain temperature above which it refuses to liquefy at any pressure, and this has been called the *critical temperature* of the gas. As the gas approaches the critical temperature, the least decrease in temperature or increase in pressure causes it to pass over into the liquid state. The critical temperature of air is 220° below zero Fahrenheit, and the critical pressure about 600 pounds per square inch, and the temperature of liquid air at atmospheric pressure is 312.6° below zero.

If liquid air is allowed to evaporate, it must absorb the same amount of heat that it lost in the process of liquefaction. This heat will be absorbed from the surrounding atmosphere when the internal heat of the gas is not sufficient to effect its evaporation; and the surrounding area —be it refrigerator car or ice-box—is thus left chilled by the absorption of its heat.

It is evident that if the car is chilled before starting on its journey, and all inlets closed, the only heat to be combated would be that coming through the walls of the car, so that the amount of refrigeration necessary in such a car would depend upon the completeness with which it is insulated or protected from outside heat. With the present system of ice refrigeration, the air in a car is full of moisture, which must be kept in circulation, and which is absorbed by the walls and renders the insulation incomplete and imperfect. In this respect, the use of liquid air, which in process of condensation has been deprived of its moisture, is far superior to ice, as the dry cold preserves the qualities of fruit and meat unchanged. This also avoids the necessity of circulation, and thus reduces tremendously the amount of new heat to be overcome as the journey progresses.

Another strong point in favor of liquid air is its weight. As compared with ice, the difference is tremendous. As compared with ammonia and carbonic acid gas, the advantage is greatly in favor of

MR G. A. BOBRICK IN HIS LABORATORY AT THE PLANT OF THE U. S. LIQUID AIR & OXYGEN COMPANY.




APPARATUS FOR MANUFACTURING OZONE FROM OXYGEN.
Said to be the only one of its kind.

liquid air by reason of the difference in the weight of the receptacles, since ammonia and carbonic acid gas must be retained in powerful and bulky steel cylinders, whereas liquid air may be conveyed in light galvanized-iron tanks. The liquid-air tank being once in place in a car, its natural loss by evaporation would be about 3 per cent per day, and this would also be the approximate loss in transporting it in the boxes lined with hair felt in which it is shipped from the plant. A simple automatic arrangement for forcing the flow and evaporation, makes use of the varying length due to expansion of an iron rod traversing the car.

The process in use in the works of the United States Liquid Air & Oxygen Company in Los Angeles, under the direction of G. A. Bobrick, is quite different from that heretofore used, and much

cheaper. Generally stated, all of the processes consist in compressing the air, abstracting the heat produced by compression, and then expanding into a suitable vessel, and directing the current of expanded cold air over or along the pipes through which the incoming compressed air flows. The cooling is thus made cumulative. The incoming compressed air gradually drops in temperature until it reaches the critical temperature, when by further expansion part of it liquefies.

In the Tripler process, the expansion is effected through a throttle valve from high-pressure to low-pressure tanks. The drop in temperature due to this free expansion, equals about one-half a degree Fahrenheit for every 15 pounds' drop in pressure at normal temperature, and is gradually increased as the temperature of the air before expansion decreases. To manufacture liquid air economically by this free-expansion process, it is necessary that the air be reduced by 3,000 to 4,000 pounds' pressure to the square inch in at least four stages, and the heat of compression abstracted during and after each stage.

In the Los Angeles plant, however, expansion is effected in a motor or turbine. The air thus performs external work, the drop in temperature depending upon the work done. In addition to this system of adiabatic expansion, and the free expansion process, there is a third which combines the two processes.

Mr. Bobrick says of the cost of production:

"In practice I prefer to compress the air to about 300 pounds to the square inch, and expand it in a turbine to about atmospheric pressure. It may therefore be seen at a glance that the adiabatic expansion process is the most efficient and economical one, as, besides the great gain in thermal advantage, about 50 per cent of the work done in the compressor may be recovered and used for compressing more air. In the third process, I prefer to compress the air to from 3,000 to 4,000 pounds to the square inch, then expand it through a throttle valve to about 60 pounds, using the air so expanded for cooling the incoming compressed air, and then expand it adiabatically in a motor to atmospheric pressure. A 500-horse-power plant will make liquid air by free expansion at a cost of about 5 cents per gallon; by the third process, at about 3 cents per gallon; and by the second, at less than 1 cent per gallon."

It is no longer seriously expected that liquid air will prove efficient and practical as a motive power, save in a small way, where it may be used as a by-product; but its use in the purification of chemicals and wines, its employment in surgery, and its constantly extending use in connection with other gases to secure burning mixtures of extremely high temperatures for use in the welding and reduction of metals, have created a steady demand for its manufacture, and for the manufacture of oxygen by fractional distillation from liquid air. When the use of liquid air for refrigeration has been shown to be practical and economical, it must at once take its place as one of the world's great staples.

# Uplifts

ALL common things, each day's events,
That with the hour begin and end,
Our pleasures and our discontents,
Are rounds by which we may ascend.

H. W. LONGFELLOW.

IT was mid-day on the tableland of Utah, and the sun's rays came down with a fierce heat. The man had crawled under a ledge of rock which afforded a little shade. Sitting on the ground, he began knocking against the edge of the rock-cleft with his pick, without thought of what he was doing. A piece of the rock became dislodged and fell at his feet. He gave it a casual glance, then one of more interest. Finally he picked up the chunk, hurriedly pulled a magnifying glass from his pocket, and studied every corner of the rough surface.

What he found caused the man to spring up and wield his prospector's pick with both hands until a dozen fragments lay at his feet. Carefully gathering up every particle, he placed them in a bag, and again started on his way thoughtless of the deadly heat, of his lips cracked for want of water. He was half insane before the desert journey was over; but he managed to reach the nearest settlement, staggered into the assay office and dropped to the floor unconscious. The men in the room lifted him up, revived him with a liberal dose of whiskey and water, and opened his bag. The experts in mineralogy were amazed. Well they might be, for the unerring crucible test showed that the chunks of rock contained so much pure silver that a ton would yield no less than twelve pounds.

Old miners in Utah still tell this story about the discovery of the Parley's Park lode. Parley lived to go back and get some of the fabulous wealth which has been taken from that desert plateau; but only a little bit, for it is an actual fact, as the records show, that over three million pounds—1,500 tons—in weight of pure silver has thus far been taken from this wonderful deposit, which might have remained unknown to this day had those idle blows of the pick not accidentally hit the very vein itself. Small wonder is it that now, as forty years ago, you can run across the "color hunter" in the mountain pass or high up on the slope, possibly wading in the ice-cold waters of a mountain stream or taking his life in his hands in the mid-desert with only the water and food packed on his back between him and death—fascinated by the lure of the gold.

There are two kinds of prospector, however—one who is satisfied to obtain the metal in any form, and the pocket-

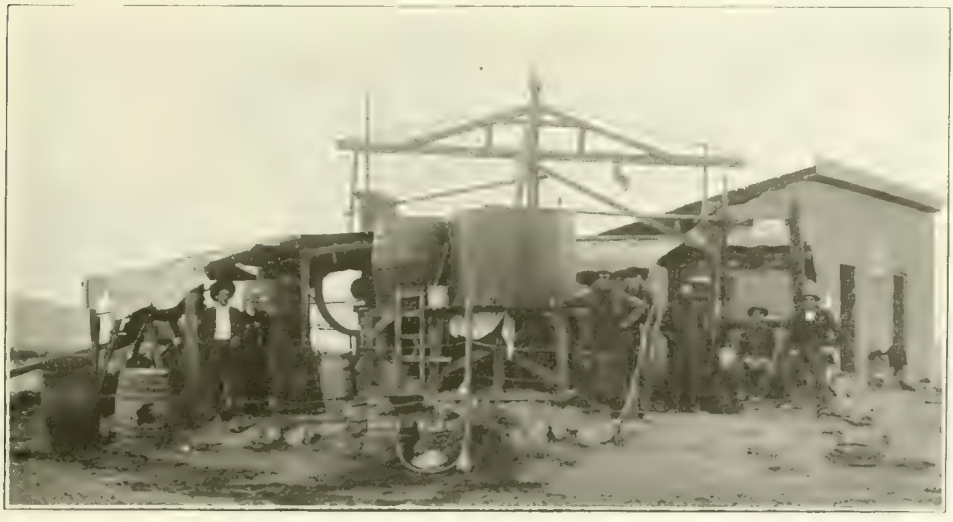
hunter. The latter individual considers himself above the other type of prospector, terming himself a "professional." Many a one has spent the better part of his life in exploring beds of streams and dry valleys in search of pockets. In Southern Oregon the pocket-hunters have, perhaps, been more numerous than elsewhere in the United States, as this section of the State has yielded a large amount of gold in this form. These prospectors, however, depend upon the pick, shovel, and pan, as do their fellows; but they seldom dig further into the side of the bank or hill than their shovel will reach, relying upon the outcropping of ore-bearing ledges to contain the sources of wealth they covet.

The ordinary prospector, as already stated, sometimes wades through the bed of the stream or tramps over its sand if it is "dry," here and there filling his pan with the material. Then, immersing the pan in water, he thus separates the sand from the other earthy matter, and gradually spilling out the particles gazes at the bottom of the pan to note any glittering streak which may betoken the presence of gold. If he is working along the side of a hill where he believes the ledge of rock may contain a vein of gold-bearing ore, he breaks off likely portions with his pick, crushes them as best he can, and, dropping the dust and fragments into his pan, repeats the separation process. Sometimes the prospector has utilized the

DIGGING WEALTH FROM THE BOWELS OF THE EARTH.

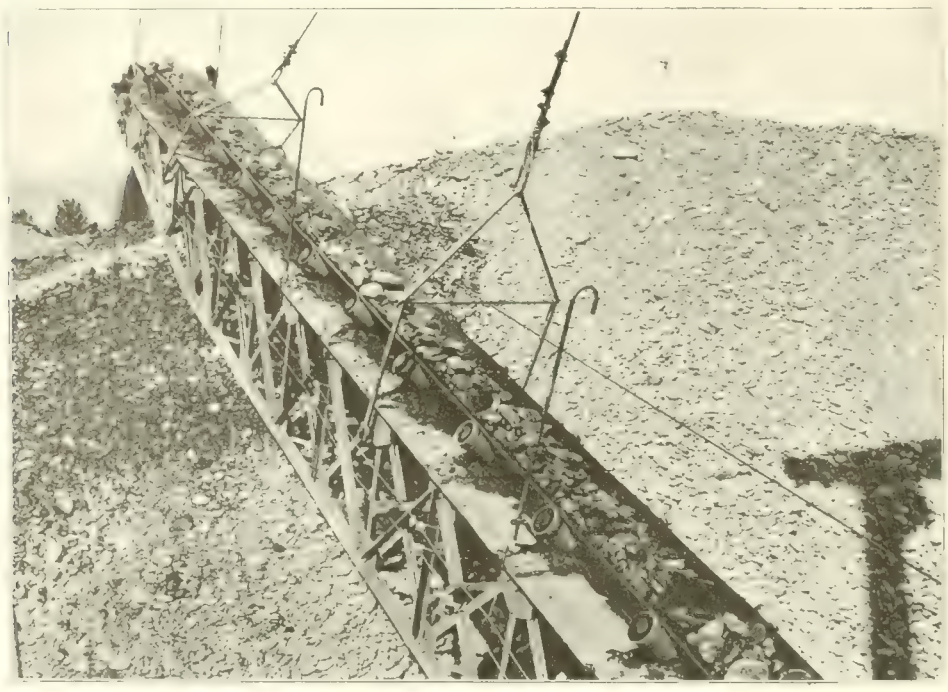
cradle as a substitute for the pan; but as the latter can readily be carried from place to place strapped on his back or on the back of his burro, he can go over more space by using the simpler process than where he employs the cradle.

But whether a man is content to get the color in whatever form he finds it, or spends year after year in pocket-hunting, fortune comes when least expected. For the story of Parley's Park has many sequels in the West. Every prospector in the Rocky Mountains has heard the tale of how old Tom Cruise discovered the great Drum Lomond mine. For years the old miner had been sluicing out the gold in the bed of a creek a few miles from Helena. Some days he secured less than a dollar's worth, and other days five times as much. The uncertainty was dis-



GOLD HUNTERS STOPPING FOR WATER AT A WELL ON THE COLORADO DESERT.

couraging; but he had experience enough to know that the ledge from which the gold had been washed must be somewhere in the vicinity; so he explored the valley, but without result. Then he climbed the sides for hundreds of feet. At last he saw a projection which was apparently rock covered with earth and leaves. A few digs with the shovel laid bare the outcropping of the ore vein which was to become one of the most famous in the world.



ONE OF THE ARMS OF A "GOLD SHIP"

After the ore is extracted, the debris is carried out by means of this arm and dumped

Montana also contains the Granite Mountain mine, which was supposed to consist merely of surface ore. The shrewd superintendent noted indications which led him to believe another ore body lay beneath. The mine owners, however, disagreed with him, and he began investigating for himself when the veins appeared to be exhausted. On the very day he received a telegram to abandon the claim, he made the discovery of the lode beneath. The telegram he sent his employers caused them to give him *carte blanche* in the way of spending their money to reach the ore. It is a matter of history that the wealth of this mine has erected some of the finest buildings in St. Louis, where the owners invested their profits.

The musical sounding word "Tonopah" has become familiar throughout the country as the title of the last-discovered wealth-producing region. The discovery of its riches reads like a romance. It was made by a Nevada lawyer whose knowledge of the yellow metal was limited to the coins he occasionally received as fees. Appointed district attorney of Nye county, he decided to make a trip into the southern part of his territory to get acquainted with its few settlers. As there was no railroad or wagon road, he started out with a pack train of burros, his outfit including a miner's pick. At nightfall on the first day out, he encamped at what the Indians call "Tonopah"—meaning "water near the surface." The following morning he noticed near the spring several ledges of black quartz which contained streaks of yellow. Hardly believing it could be gold, he brought back some pieces. On being assayed,

some of the specimens showed an average of $500 in gold to the ton. The young lawyer confided in his wife and one or two friends. They fitted out an expedition, and, returning to Tonopah, located several claims. The wife was asked to christen the first one and called it Mizpah. Two tons of ore taken from this claim yielded enough gold and silver to pay all the expenses of the party, the haul of 150 miles to the railroad, transportation and smelting charges, and leave a surplus of $600 to the discoverer.

PANNING GOLD DUST ON THE BEACH AT NOME, ALASKA

This happened in 1900. Since then, silver and gold to the value of five million dollars have been taken from the earth within a radius of two miles from the spring. A city of over 5,000 people has come into existence in this Nevada desert.

But the Mizpah, named by the wife of the Nevada wealth-finder, has been true to its title; and to-day, as six years ago, is the richest of all the claims. On it the miners have driven a tunnel nearly 2,000 feet long, every foot of which is inclosed by gold and silver ore.

There are darker chapters in the history of the western gold hunters—for example, Treasure Hill, situated in Nevada, the State which the Comstock lode has given such a reputation. Nearly a half-century ago, the ore from fully a hundred openings in the mountain side on which it stands was brought to Treasure Hill, making it one of the richest and for the time one of the most active communities in the West. Companies were formed by the score to secure the deposits of precious metal. Then came the day when the pioneer miners, cutting into the hillside, found the veins were "pinched." They began selling stock in companies in which they were interested. As quickly as when the veins were dis-

A "GOLD SHIP" IN OPERATION.

These giant dredges, operated by electricity, scoop up 5,000 tons of earth daily, and separate the yellow flakes from the sand and rock.

entered, the announcement spread that the richest ore-body was in sight. A panic followed, and Treasure Hill was deserted. Possibly its hotels, stores, and dwellings are standing yet. A few years ago a traveler chanced through the place, and saw glasses and bottles on the bars of the saloons, cues and balls on the billiard tables in the hotels, row after row

of dwellings, some with doors open, but not a human being was visible.

Yet the day may come when some prospector will again explore the shafts and tunnels, and perhaps with a few blows of his pick will open up another source of wealth as great as that which built the city. The history of the Comstock lode proves that such is not impossible. This great group of mines has perhaps had as many ups and down since the first shovelful of ore was taken out of the earth as any in the world. Its valuation in the stock market shows how it has been regarded. James G. Fair discovered a mass of ore in 1875 when people were leaving the town by hundreds, just as they had deserted Treasure Hill, and empty houses were being bought to be torn to pieces for firewood. Then came the bonanza announcement, and in a short time the value of the property was estimated at no less than a hundred million dollars. Within twenty-five years it had shrunk to less than $2,000,000. Last year the value of the metal it produced was about $1,500,000. Still another mass of ore may be discovered any day which will again increase its value ten-fold or twenty-fold, although the most optimistic dare not predict that the discovery which Fair made—purely by accident—will ever be equaled, for the ore extended no less than 1,300 feet in length, while its width was over 500 feet—every ton worth at least $1,000.

The newspapers of late have had all sorts of stories about "Scotty" and his hoard of wealth in the Death Valley of California; but in Southern California is another region which may any day prove a bonanza to the gold hunter. It is a "lost mine." Back in the early eighties a man with one leg of flesh and blood and one of wood stumped into a saloon in what was then a little border settlement. Throwing down two or three lumps of a dingy reddish-colored substance on the counter, he exclaimed: "Will that pay the price of a drink?"

The bar-tender picked up a lump and turned it over between his fingers. He picked up another, then called a man who was sitting at a table. "Come here, Bill, what do you make out of this?"

Bill looked at the lumps with the critical eye of an expert, then at the one-legged visitor. "Wher'd you get this?"

"That's just what I ain't tellin'. What I want to know is, do I get a drink?"

"I reckon you do. That's some of the finest burnt gold as I ever seen."

While "Pegleg," as they called him, got as drunk as a lord to celebrate his find, no one could make him drop the slightest clue as to the location, except to say that it was "over there," pointing to a group of three mountain peaks. In a few days he had parted from all his nuggets and left town. Though followed by an eager band of gold-hunters, he managed to evade them, and they searched in vain for his treasure. In a few weeks "Pegleg" turned up with another lot of nuggets, and when these were gone, disappeared in the desert—never to be seen again. Years passed, and the "Pegleg mine," as it had been dubbed by people in that part of California, had been nearly forgotten. Work had begun on the building of the Southern Pacific Railroad; and the town

where Pegleg had first shown his wealth was full of engineers, foremen, and laborers. One day a squaw came into the place to buy some meat, and astonished the market man by offering him a nugget the size of a man's thumb in payment. News spread like wildfire that the "Pegleg" mine had been found again, but no amount of persuasion could induce the Indian woman to reveal her secret. She merely pointed to the three peaks. Immediately there was an exodus from the place; but while many never reached the mountains, dropping down on the way or returning deterred by the hardships of the trip, the experienced prospectors who explored the region did not find a trace of the color. The squaw started off with her food, but never returned, and was probably murdered by some of the wealth seekers, for the gold she might have concealed about her. The three peaks are plainly visible from the Southern Pacific trains, and are often pointed out to the passenger as the location of the Pegleg mine.

But there are prospectors out in California with muscles of steel and nerves of wire, whose movements are actuated by the electric current. Strange as it may seem, these prospectors are following in the very path of the Argonauts of '49, for they are working in the abandoned placer mines which turned the country along the Yuba river literally upside down. The natives call them "gold ships," but no stranger craft ever floated, for they actually make their own waterway. In short, they are great floating dredges which are wrecking the landscape in this part of the State in their eagerness for riches.

WASHING GOLD DUST FROM THE HILLS BY MEANS OF HYDRAULIC "GIANTS."
Scene in eastern Washington.

A few years ago the idea occurred to some genius that these miles of gravel workings in the vicinity of Oroville might still have gold enough to sift them over; but the question arose, how to do the sifting economically and efficiently.

The dredge answered the question, and now over a dozen of the gold ships are digging up the country again and throwing it into little mountains behind them,

they eat their way along—sometimes through merely a bank of sand and gravel, but sometimes through a farm or orange grove, for field and orchard are being ruthlessly torn up when necessary to satisfy their ravenous appetites. As stated, the dredges move in a pond of water just about large enough to float them. Armed with an endless chain of steel buckets, day and night they keep digging away, the buckets of material being hauled aboard, emptied, and the stuff washed in sluices, just as the prospector who was here fifty years ago washed out his dirt. Stretched across the sluices, however, are bars or riffles containing mercury, which catches the gold and holds it, the rest of the debris being piled up back of the gold ship.

And it is an actual fact that the amount of gold secured is so small that it averages less than twelve cents' worth to a ton, so that although each of these giant diggers scoops out and sorts 5,000 tons of rock, sand, and gravel every twenty-four hours, it secures only $600 in gold for its work. It must be kept steadily in operation to pay its cost and maintenance; and this is why the electric current that actuates its machinery, may not be cut off for months at a time. It's not a cheap prospector, for to build the smallest of the lot required $50,000! but if the color is there, it is sure to find it. It makes no mistakes, and never gets tired.

# Making Good

THIS world was not constructed for the lazy man of dreams;
One flash is not a nugget—gold is constant with its gleams.
The world keeps looking higher than the level you've attained,
And thinks you retrograding till 'tis certain you have gained.

No standstill will it tolerate; slide back, and you will see
Your name among the "has-beens" as a harmless "used-to-be."
The standard you established when you did the best you could,
Was but your affidavit that you'd keep on making good.

—SUCCESS MAGAZINE.

# Electricity as Housemaid

## By Sidney James

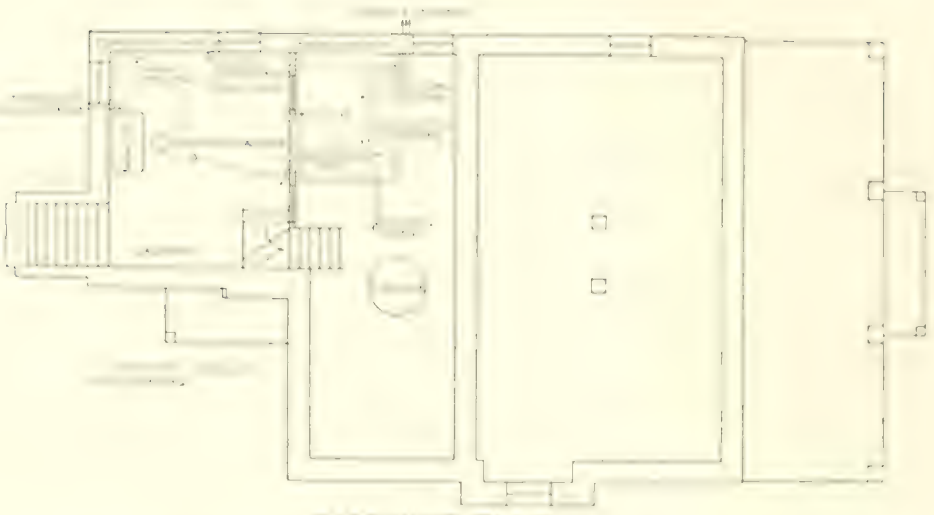
IN prehistoric times men built houses without stoves or chimneys—crude structures roughly put together or hollowed out of rocky hillsides. Today they are about ready to do the same thing, but in a different way; and the modern house without a chimney, while not yet actually realized, is a possibility of the near future, which will represent the very latest triumph of scientific progress and mechanical skill as applied to domestic welfare.

Electricity has made this possible, without sacrifice of comfort or convenience. The subtle current, in fact, has been so harnessed and trained to serve man's uses that it has become an indispensable factor, not only in the larger field of commercial and municipal life, where its usefulness was first developed, but also in the domestic life of the home. Here at last it comes, insisting, with claims that cannot be gainsaid, that it is the best of house-servants. It is untiring, responds promptly to call at any hour of the day or night, cares naught for holidays or special privileges, and is the very genius of comfort, cleanliness, and good health.

The first house ever built to illustrate the complete application of electricity to the uses of domestic life, is shown in the accompanying cut. It is the home of Mr. H. W. Hillman, of Schenectady, N. Y.,

WHERE ELECTRICITY IS SERVANT.

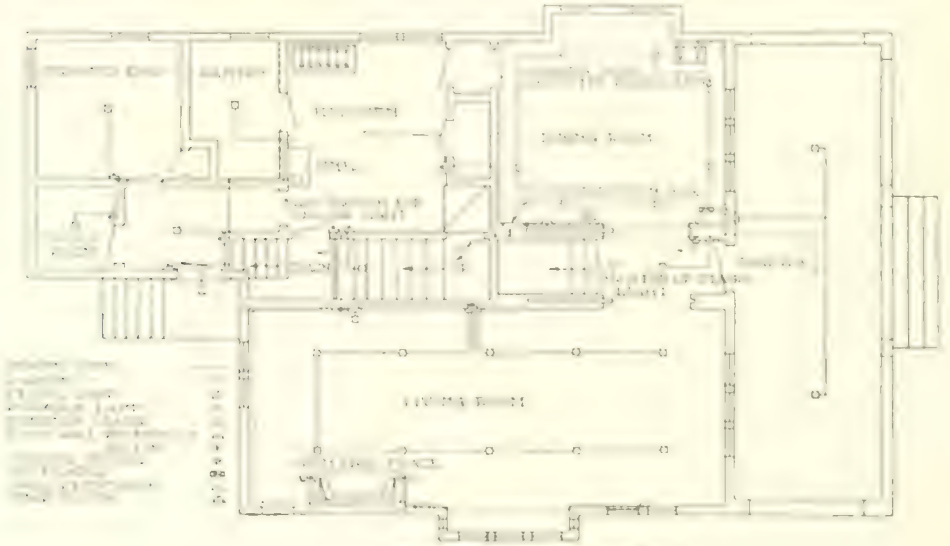
Residence of H. W. Hillman, Schenectady, N. Y. First house ever built representing the complete application of electricity to the uses of domestic life. Not only heated and lighted by electricity, but equipped with every conceivable electrically-operated device for cooking and other domestic purposes.



BASEMENT PLAN

HEATING SYSTEM BASEMENT PLAN IN RESIDENCE OF H. W. HILLMAN, SCHENECTADY, N. Y.

and was built in the spring of 1905. It strikingly illustrates the principle of the "survival of the fittest," for under all ordinary conditions of the weather it [illegible] all such useless appendages as chimneys. This house is equipped with every conceivable manner of electrical device for doing the work of the household—lighting and warming the house; chopping the meat and vegetables, cooking them, and boiling the kettle; running the sewing machine; and so on. In principle these devices are not new—for they embody simply the well-known principles of the use of a magnetic field to produce motion, or of a resistance in a circuit to produce heat—but in their variety of appli-



FIRST FLOOR PLAN

[illegible] IN THE HILLMAN RESIDENCE, SHOWING SYSTEM OF WIRING FOR VARIOUS ELECTRIC DEVICES

cation of these principles they are veritable triumphs of ingenuity.

The house, moreover, is prophetic of what the future holds for the electrical engineer in his own peculiar and rapidly expanding field. For while it is true that homes have been electrically lighted for many years, and hardly a house is now erected which is not wired for electric illumination, it is also certain that the time is near at hand when residences will be wired, not only for lights, but also for all the other conveniences of electric heaters and motor devices without which the modern home will not be complete.

The following data regarding interior arrangements and cost of service have been supplied by Mr. Hillman himself for the convenience of readers of the TECHNICAL WORLD MAGAZINE. They are of special interest as covering a subject on which very little has heretofore been published.

The house is about 57 feet long and 35 feet wide, with five bedrooms, two bathrooms, a music room 35 feet long, living room upstairs, dining room, and kitchen. In the basement are a good-sized laundry, a store-room, a furnace room, and coal-bin.

BATHROOM.
Electric heater at right.

"Owing to my past experience with electrical devices in the kitchen," says Mr. Hillman, "I requested a Boston architect, Mr. W. E. Lovering, to draw up two separate plans—plan No. 1 to be without a kitchen chimney, to have no kitchen coal-bin, and a cellar under part of the house only. That part under which there was no cellar, was, of course, well ventilated. The foundation for the front part of the house was to go down only to frost line. Plan No. 2 included a cellar under the entire house, a kitchen chimney, kitchen coal-bin, and cement cellar floor. The two plans were submitted to contractors; and I found, upon securing bids, that by adopting plan No. 1, I could save more than enough money to pay for the extra wiring throughout the house, and buy a complete line of attractive electrical cooking, baking, and ironing devices, radiators, chafing-dish,

ELECTRICAL FOUR-COMBINATION CEREAL COOKER.

and other miscellaneous electrical articles. It is needless to say that I adopted plan No. 1; and the diagrams show the general lay-out of wiring for both lighting and heating devices. Having the wiring nicely arranged, and convenient in all rooms, permits of our performing a great many operations in connection with household duties, by means of electricity.

"We entered the new house in September, 1905. The electric kitchen equipment was connected within two minutes from the time the table was taken off the wagon; and there was no waiting around for the stove man to come and connect up the stove, fit the stovepipe, build the fire, etc. For nearly three years we have cooked and baked by electricity daily; and the new kitchen, therefore, has no coal or gas range.

One of the illustrations shows the simplicity of the cooking and baking outfit, consisting of a wooden table about four feet long and three feet wide, standing at about the same height as a coal or gas stove. This table is equipped with seven regulating switches for turning the current off and on. Three of these switches have one heat only, and are used for controlling small dishes. The others are devised for three heats known as "maximum," "medium," and "minimum." For example, in starting to bake, the girl turns the switch for high heat. In fifteen minutes the oven is ready for baking; and at the proper time the regulating switch is turned for securing medium or minimum heat. The switch can be turned by rotating the handle; and it is as convenient as turning an incandescent lamp off and on. The three-heat switches are also used for such devices as the four-combination cereal cooker and the meat broiler—also the electric vegetable kettle—all of which are designed so that the degrees of heat desired may be varied. Such switches represent an advance in the art, as they are compact in form, inexpensive, safe, and perfectly control

A COMPLETE ELECTRIC COOKING AND BAKING OUTFIT IN USE

| DAYS | BREAKFAST 6.30 8.00 | BAKING 8.00-11.00 | IRONING 7.00-12.00 | DINNER 11.30-1.00 | MISC. DAY | SUPPER 4.30 8.00 | MISC. NIGHT | TOTAL |
|---|---|---|---|---|---|---|---|---|
| MONDAY | ¾ KW.H | 1 KW.H | 0 KW.H | 1½ KW.H | 1¼ KW.H | ½ KW.H | 0 KW.H | 4 KW.H |
| TUESDAY | 1 KW.H | 0 KW.H | 2½ KW.H | 1½ KW.H | ¾ KW.H | 1 KW.H | ½ KW.H | 7 KW.H |
| WEDNESDAY | ¾ KW.H | 3 KW.H | 0 KW.H | ¾ KW.H | 0 KW.H | ½ KW.H | 0 KW.H | 5 KW.H |
| THURSDAY | ¾ KW.H | 0 KW.H | 0 KW.H | 1 KW.H | ¼ KW.H | 0 KW.H | 0 KW.H | 2 KW.H |
| FRIDAY | 1 KW.H | 0 KW.H | 0 KW.H | 1 KW.H | 0 KW.H | ½ KW.H | ½ KW.H | 3 KW.H |
| SATURDAY | ¾ KW.H | 3 KW.H | 0 KW.H | ¾ KW.H | 1 KW.H | ½ KW.H | 0 KW.H | 6 KW.H |
| SUNDAY | ½ KW.H | 0 KW.H | 0 KW.H | 2½ KW.H | 0 KW.H | 0 KW.H | 1 KW.H | 4 KW.H |
| TOTAL | 5½ KW.H | 7 KW.H | 2½ KW.H | 9 KW.H | 2 KW.H | 3 KW.H | 2 KW.H | 31 KW.H |

DIAGRAM SHOWING ELECTRIC CURRENT USED DURING ONE WEEK, FOR COOKING, IRONING, ETC.

the heats for the various dishes. The principle of regulation is not only simple, but very practicable. For illustration, the large frying pan, having been used for frying the eggs and bacon, can be left with minimum heat for keeping the food warm, whereas the food would be spoiled if the dish had only one heat. The food would either be over-cooked, or, if the switch were turned off, would get cold. The gridiron cooks the most delicious brown cakes, and requires only two minutes' notice for maximum heat. The meat broiler is ready in about the same time. In our many years' experience with other systems for cooking and baking, we have not found any other system so quick and convenient as the electric.

"The four-combination cereal cooker is a most interesting kitchen article. First it is used as a hot-water heater for heating the water in the morning for breakfast. At night, before the girl retires, she arranges the water in the dish ready for use in the morning. Upon awakening, and before getting out of bed, she turns the side wall switch which throws the current on, and starts the water heater. By the time she is dressed, washed, and in the kitchen, the water is boiling She places part of it in the coffee percolator, and then the second combination is brought into use. The dish is now being used for cooking a cereal. After the cereal is ready, the dish will be used as an egg boiler. Later in the day, it is used to steam the potatoes. These combinations not only represent convenience in handling, but they represent a saving in the first cost of kitchen dishes, and effect economies in operation never before known in the art. Such combination devices will enable the reader to appreciate why cooking and baking by electricity are so reasonable in cost of operation.

"We have the following list of articles in the electric kitchen outfit:

(1) Electric table, with controlling and regulating switches mounted thereon, and fully wired, ready to connect quickly to the house wires.

(2) Electric oven with three variable heats.

(3) Electric griddle-cake cooker, three heats.

(4) Electric meat broiler, three heats.

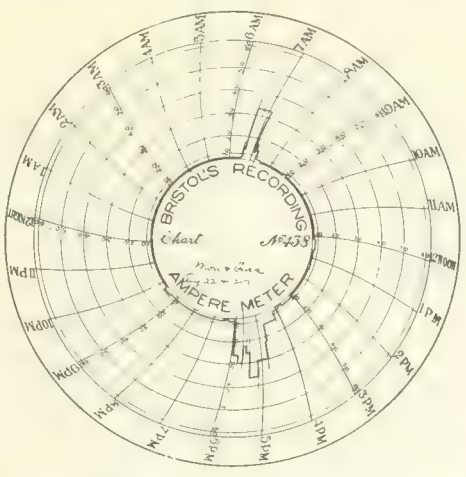
(5) Electric combination cereal cooker, water heater, egg boiler, and potato steamer.

(6) Electric frying pan.

(7) Electric coffee percolator.

(8) Stove for using ordinary cooking utensils.

"For large families of seven to ten per-




A 24-Hour Record of Current Used in Hillman Residence, August 22 and 23, 1905.

As the disc revolves, a pen automatically traces the record here shown by heavy black line, indicating greatest use of current at breakfast and dinner hours.

...es, the above dishes may be duplicated if desired, or a large 4-quart electric kettle may be required. The above outfit, however, is practicable for our family of five, including the girl. This outfit can be purchased for about $55, including the table, switches, and devices complete.

"As regards cost of operating, the most intelligent way to explain this item is to draw comparisons with monthly costs of operating with coal and gas. The writer has had ten years' experience

...

with kitchen range, with coal at $6.50 per ton on the average; also six years' experience with gas at $1.30 per thousand. Our gas bills would average about $3.00 per month. We used the coal range Monday and Tuesday for washing and ironing, and burned a little less than a half-ton of coal a month, at a cost of about $3.00. The average monthly cost of operating was therefore about $6.00 for kitchen coal and gas, with an additional cost for carting away ashes.

"Many readers will be surprised to learn that my average monthly cost for electricity for two years has been $6.69 a month, or only 10 per cent higher than coal or gas. There are no ashes to cart away, no fires to build, and the electric system offers a neat, clean, healthy kitchen.

"For the benefit of those readers who might possibly be inclined to doubt my figures, I would add that I have made most exhaustive tests of an engineering character on my electric circuits. Recording ampere meters have been placed upon the heating-device circuit for weeks at a time, for the purpose of giving me daily, hourly, and five-minute records of exactly how much electricity is being used, and exactly at what time of day or night. This data has been checked carefully with my recording wattmeter readings, and my monthly bills as furnished me by the Illuminating Company during the past thirty months. For the particular use of this article, I had a recording ammeter placed on the circuit for one week, and give herewith a table showing the amount of current used during the week, and the time of day when it was used. Great confidence may be placed in the figures, not only because of a long period of experience of a most practical character, but because of data given me recently regarding a family of three who used electricity for cooking, baking, and ironing all last summer.

"The rate charged for electricity for lighting in Schenectady is 15 cents per kilowatt-hour. A discount brings it down to 10 cents per K. W. hour. For heating devices, such as cooking and baking, they make a special rate of 5 cents net; and the figures which I have given are based upon the 5-cent rate for heating-device circuits.

"We have used many other miscellaneous electrical devices in addition to the kitchen outfit. For example, in the dining room is a small electric table in quartered-oak finish, wired for chafing-dish and percolator.

"On the veranda and in the den, the electric cigar-lighters make matches in the house an unknown quantity, and they never fail to interest visitors who have not before known of their convenience and usefulness.

"In the sewing room, the sewing-machine motor and three-pound nickel-plated electric iron are articles which never could be taken away from the house without much opposition from Mrs. Hillman. They have become so necessary that they are used as commonly as scissors, thread, and workbox. The

first cost of such devices represents but a small sum; and the cost of operation is hardly noticed on one's monthly bill at the regular rate charged for lighting, to say nothing about the special heating rate.

"The electric massage motor is another device that can be screwed into any lighting socket, and its cost of operation is negligible Many a day this device is handy for quick service when one misses his daily exercise and desires to keep in good physical condition.

"The bathroom is complete with electrical conveniences. The electric shaving mug furnishes hot water, for shaving, in less than one minute. The luminous radiator takes the chill off the room; and two cents' worth of electricity for fifteen or twenty minutes has made the room comfortable and cheerful.

"A great many of these devices may be placed on regular lighting sockets; and thus readers who are interested can secure some of the small miscellaneous articles, such as the coffee percolator, chafing-dish, electric heating pad, shaving mug, cigar lighter, sewing-machine motor, small flat-iron, massage motor, laundry iron, etc.

"As people become acquainted with these conveniences, architects will desire to know about special electrical wiring, and many electrical contractors and architects will be interested in studying the subject from the standpoint of convenience to the people. It is not only my own convenience that leads me to believe thousands of others would like such devices, but it is the great interest which many visitors at our house have taken in them. Those people who have electric lights in their homes will want to try some of the smaller and attractive articles, and those whose homes are not wired for electric lights will appreciate how much more convenient their homes may be made by the use of these electrical devices, with their low initial cost and their small operating expense."

COOKING AND BAKING OUTFIT.
The seven regulating switches are in a row at the back of the table.

# What Strength is For

NO one could tell me where my soul might be;
I searched for God, but God eluded me;
I sought my Brother out—and found all three.

—ERNEST CROSBY.

# Street-Railways Which Repair Themselves

By Henry Hale

The city of Philadelphia has one of the most remarkable street-railways in the world, for the electric power which whirls the trolley-cars upon it also furnishes the mechanical muscle by which it repairs itself and, when it desires, enlarges itself by the mile.

The term "trolley current" is often heard in this country because the electricity is usually generated merely to move the cars and occasionally to heat and light them. On the Philadelphia line, however, it melts iron and steel, cuts bars of steel in two, punches holes in the rails, drives air-compressors, scours the rails with sand, does riveting and bolting, runs a drop-hammer, drives piling for bridges —and does it all just as the cobbler patches the shoe—while you wait. And if any of the work is to be done at night, it throws in the light as well. The railway system referred to is that controlled by the Philadelphia Rapid Transit Company, which operates the greater portion of the trolley-lines in the city and immediate suburbs.

Probably the most interesting apparatus is that used for rail-laying. It includes a sand-blast machine, power drills and riveters, as well as a portable outfit for melting metal at the scene of operation. As these appliances are closely associated with one another in the work, a brief description of the plan followed is essential in illustrating their importance. The first process in laying the rails is that of preparing them for jointing. In this work the sand-blast has been found to be of much value in removing foreign matter from the surfaces of the rails where

the jointing is to be effected. For drilling, a pneumatic machine is used, being applied to the side of the rail; and air is furnished in the usual manner by hose connection with the compressed-air reservoir. Nearly all of the riveting, too, is performed with compressed-air tools. After being clamped to the sections of rails to be jointed, the rail is held in position by a pivotal crane on the wagon containing the compressed-air reservoir. As already stated, however, the air power is really produced by the electric current which drives the air-compressor.

One of the essentials in track-laying is a punch. The kind used on the Philadelphia Rapid Transit System is operated by hydraulic power, water and glycerine being employed. As it is frequently necessary to cut the rails at terminals and other points where short lengths are required, a cold saw forms part of the track-laying outfit. The electric current may be utilized directly, the saw being connected to an electric motor by means of a telescopic shaft and universal joints. This form of connection allows the motor to be placed at variable distances from the saw. All of the apparatus is so light that it can be placed on a wheelbarrow and trundled by hand along the line to the most convenient point. Then a connection is made with the trolley-wire, and a push of the controller switch starts the motor.

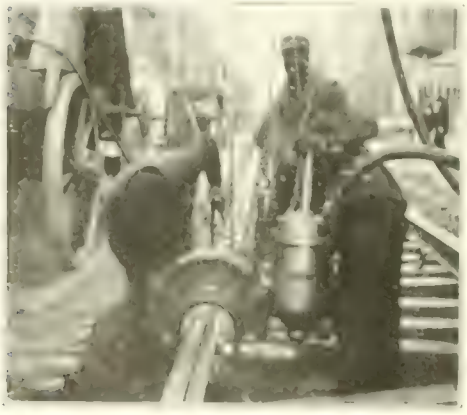
LIGHTS INSTALLED FOR REPAIR WORK.
Served by current secured from trolley wire by fish-pole connections.

For several years the engineers of this company have been experimenting with different forms of rail joints. They have adopted the "cast-weld" joint, as it is called; and, for making it, use a portable cupola outfit. At first a cupola having a capacity of nearly one ton of iron was used. The blower was operated by a 5-horse-power motor carried on the same truck. This apparatus, however, has un-

COMPRESSED-AIR OUTFIT, WITH TANKS SERVING THE BORING TOOLS.

ELECTRICALLY OPERATED DROP-HAMMER INSTALLED FOR SERVICE.

[illegible] composite rail joint is made, which has proven very satisfactory. The joint consists of a [illegible] of sole-plate metal to the web of the rail, [illegible] zinc poured in between the plates and the web and into the space immediately underneath the rail-head. The plates are heated by four oil-burning heaters before being placed in position. Oil is also used as fuel in melting the zinc, being fed to the furnace by means of an air-jet. Two



furnaces are sufficient to melt the quantity of zinc required, and all of the apparatus is carried upon a single truck. To furnish compressed air for the melting furnaces and plate heaters, a compressor operated by an electric motor is placed on the truck. The air is delivered at a pressure of 20 pounds.

When a stretch of track is to be laid or relaid, the trucks containing the sand-blast, drilling and riveting tools, and melting furnaces, as well as a special truck provided with air-compressors and reservoirs, are hauled to the locality, the sand-blast apparatus being in front and the melting furnaces in the rear. In this way, one set of rails is being prepared for jointing while the work is being completed on another set; yet, for all these operations, actually less than a score of men are required. The air from the reservoirs is supplied by hose to the different tools, except the melting furnaces, which, as already stated, have their own compressor. Even the crane for supporting the riveter and joint can be operated by air if desired. The air-compressors in each case are direct-connected to electric motors, taking current from the trolley-wires.

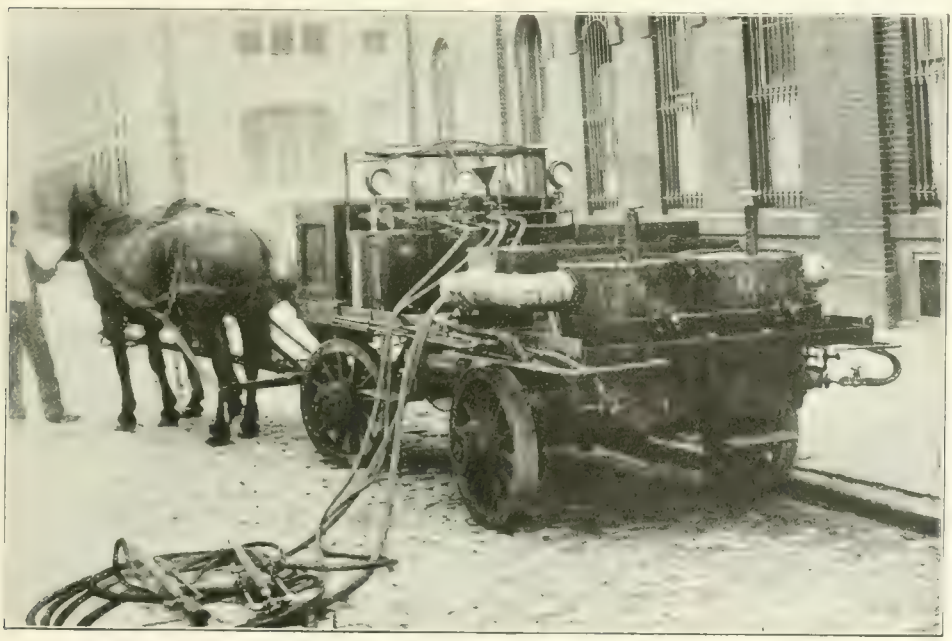
Rail-laying, however, represents but one portion of the work necessary in street-railway construction and repair. Various other devices, also worthy of note, are therefore found in use. For breaking welded joints of old rails, a portable drop-hammer has been found of great value. It is mounted on a special truck hauled from place to place by another car. The drop weighs 1,600 pounds, and the framework supporting it affords a fall of 17 feet, which has been found sufficient to break the heaviest joints, usually at a single blow. The movement of the drop is controlled by a winch operated by an ordinary street-railway motor, so that the services of but one man are required, and he is generally the motorman of the car hauling the drop-truck.

Where it is necessary to grind the joints after welding, an emery wheel, operated by a 2-horse-power motor connected to it by a flexible shaft, is employed. The emery wheel and motor are carried on one of the trucks, and are of such small size that they can be easily carried in a wheelbarrow along the line and used where necessary. Current, here, too, is taken from the trolley wire by a "fish-pole" joint, so that when the

BORING HOLES WITH PNEUMATIC MACHINE.

grinding is completed it is necessary only to lift off the pole and carry the apparatus to the next section of rails. Night work or any other operation requiring light, is carried on with the aid of incandescent lamps using the trolley current. The fish-pole joints are set in movable standards and can be used singly or in series as desired, the lamps being placed in single or double rows in adjustable reflectors, so that the light can be thrown at the proper angle.

Track material, including the longest rails, is carried on a motor-car of novel form, designed for this purpose. It consists really of two cars, each having its own set of trucks as well as its own trol-

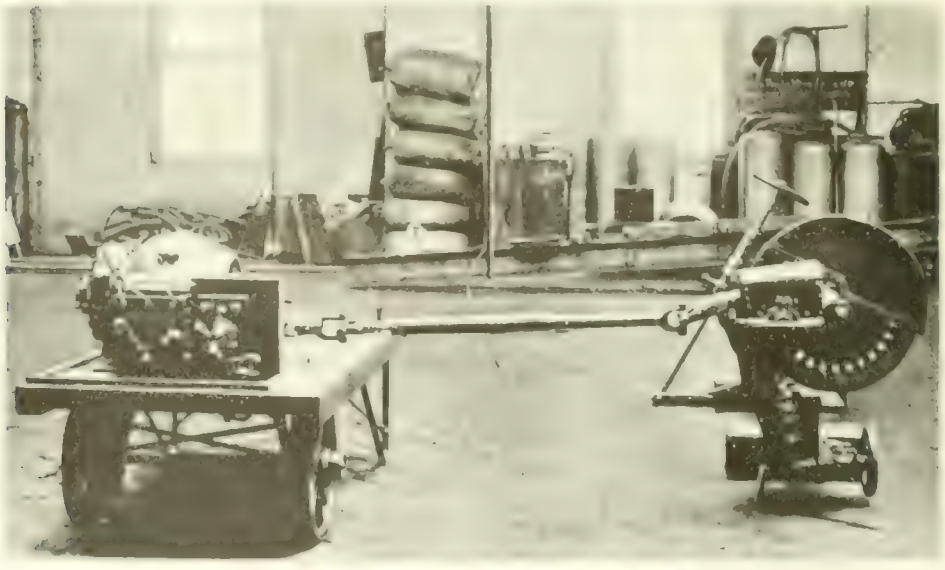


ZINC MELTING OUTFIT.

compressed air, is employed. By this means three men can do all the unloading.

About the only apparatus which does not depend directly or indirectly upon the current from the overhead system, is the road-roller; and even this is carried from place to place, hauled by a trolley-car on a specially constructed truck. The charter of the company requires it to keep a certain portion of the pavement of the streets traversed by its lines in proper condition. For surfacing the macadam and asphalt, a steam road-roller of ordinary pattern weighing 15 tons is employed. The truck on which it is carried is provided with an inclined platform, so that when the roller is to be loaded or unloaded it is necessary only to attach this platform to the rear end of the truck, when the machine can be transferred by its own power and without other aid.

Considering the extensive employment of electrical apparatus, only a small amount of power is required to operate



RAIL TRANSPORTATION CARS IN SERVICE.

it. All the main air-compressors, for instance, are driven by a 500-volt motor of but 10 horse-power. It is mounted directly on the frame of the compressor, and drives through gearing. These compressors furnish all the power for drilling and riveting, as well as for the sand-blast. The power required for the other apparatus, excluding the rail-carrying cars, is not more than 25 horse-power.

# As He Put It

IF of all words of tongue or pen,
The saddest are: It might have been;
More sad are these we daily see—
It is, but hadn't ought to be.

—BRET HARTE.

# Uncle Sam's Oversight

## By Elliott Flower

WHEN Uncle Sam had his little settlement with Mexico, out of which he derived considerable southwestern territory, he generously allowed Mexico to retain a pile of rocks for which he thought he could have no particular use, this particular rock-pile being known as Baja (Lower) California. There seems to have been no reason why he should not have had these rocks, except that he did not want them. So he drew a line from the junction of the Colorado and the Gila rivers, straight across to the most convenient point on the coast, and decided that Mexico might retain what lay south of that line.

A Mexican Mission in Lower California

While this is history, it is just as well not to recall it when you happen to be in Lower California. The Mexicans do not like to be reminded of the fact that Uncle Sam got the territory to the north, and the Americans do not like to be reminded that they overlooked the value of what lay to the south. For, in Lower California to-day, there is no man so poor that he may not have a pleasant, plausible dream of wealth. Indeed, it is quite probable that, had the Mexican dreamed less, he would now have more of the wealth within his grasp. As for the American, he is after the wealth in his own strenuous way, tempered somewhat by climatic conditions; but he feels that he would have a much better chance under Uncle Sam's beneficent rule.

And no doubt he is right. One cannot be in the country very long without feeling that its development has been retarded by Mexican rule—not so much the restrictions of Mexican rule, perhaps, as the lack of facilities and encouragement for the work of developing it: there is nothing progressive, no effort on the part of the Government to assist in the exploitation of its resources. So the Americans who have interests there—and Americans are largely connected with the more important and progressive enterprises—never cease to regret Uncle Sam's oversight.

Possibly, if you saw valleys on the other side of the line which, with no greater natural advantages than those of Lower California, were made surely profitable by irrigation, you would be disposed to grumble, also. A good irrigation system requires co-operation, a large investment of capital, and some-

ON UNCLE SAM'S SIDE OF THE LINE.

times government aid and encouragement —which serves to explain why Lower California lags behind. The climate and the soil are excellent. Topographically and climatically, this 600-mile peninsula is said to resemble Italy more nearly than any other place on the map of the world. Beginning in the mountains, 5,000 to 10,000 feet above sea-level, there is a gradual slope to the Pacific coast which gives almost any desired climatic conditions except extreme cold. On the Gulf side the descent is rugged and abrupt.

Very likely you have fallen into the error that Uncle Sam made in the long ago, and think of Lower California, when you think of it at all, as a barren waste of rock mountains. This is quite excusable, for the country has suffered much from reaction after over-booming. Men were first lured there by those fabulous tales that have done so much harm to other localities where gems and gold have been found: they were given false ideas of conditions, and they went improperly prepared. This world nowhere provides the reality that would equal the expectations of those early colonists and adventurers; and, in their disappointment, they gave Lower California an evil name that kept people away from it for many years. It produced nothing but rock, sage, rattlesnakes, and tarantulas, they said, and might be swallowed up by the sea without involving any loss to humanity. It naturally followed that people forgot about it and left it to the In-

ON THE MEXICAN SIDE OF THE LINE.

A RANCH IN LOWER CALIFORNIA

dians; and it has taken many years to discover that the Indians have something that is too good for them to appreciate.

As a matter of fact, Lower California produces about all the varieties of cereals and fruits that are produced by southern California, and some that its northern neighbor cannot raise. There are dates, oranges, lemons, pineapples, bananas, peaches, quinces, plums, apples, pears, melons, figs, grapes, and cocoanuts. Furthermore, the same care and cash expenditure that has made of southern California a fruit country would do as much, or more, for Lower California. It needs the irrigation that has done so much in Uncle Sam's country. Without that, it cannot produce the fruit in sufficient quantities to cut any figure in the market; but, without that, southern California would be shipping no fruit at all. The natural conditions are about the same. You may see, on one side of the boundary, a ranch that is a delight to the eye and that is sending its carloads of fruit to the eastern market, and, only a few miles away, a ranch that is forlorn, desolate, and unprofitable. The one is irrigated and the other is not.

The conditions compel many of the people on the Mexican side of the line to give to cattle land which, with irrigation, could be much more profitably used in other ways. Even then, they are at a great disadvantage. Owing to the lack of transportation facilities, the cattle cannot be fattened at home, but must be driven to Imperial, across the line, for that purpose. To drive them such a distance after they are ready for the market is naturally out of the question; so Imperial takes them and ships them along when they are ready for the butcher, and you, who possibly get one of the steaks, probably have an idea that a cow could not live in Lower California. There is cheese, also, as a result of this cattle-raising; and that brings up another penalty of Uncle Sam's oversight.

The United States is the natural market for nearly all the products of Lower California. But the tariff intervenes. The important ports, especially of the upper half of the peninsula, are on the Pacific coast side. The east coast is the more rugged, barren, and precipitous part; and, at the northern end, the Colorado

WHERE GEMS ARE FOUND.
A characteristic landscape in Lower California.

Desert lies between Lower California and the rest of Mexico. So the natural market is to the north, where Uncle Sam rules and imposes duties. In the matter of cheese, by way of example, the duty is practically prohibitive; and men within a few miles of the United States have to freight their cheese by wagon long distances through the mountains to Ensenada. And the same is true of many other things.

As for irrigation, which would permit much of this land to be used in more profitable ways, the natural conditions are extremely favorable. There is plenty of rain; but, unfortunately, it is not properly spread over the year. The mountains give ample opportunity for storing water at an altitude that would make it available; but, again, there is not the money to do the necessary work, and, in some localities, land-title uncertainties discourage investment. I passed through one valley, high in the mountains, above which there is a gorge that could be made into a splendid reservoir by the investment of a few thousands of dollars; but the money, even in that inviting instance, is not available, so the land is used principally for grazing when it is used at all. At the same time, there are ranches, near the coast, upon which the various fruits are successfully raised; and the people confidently believe that the conditions and encouragement to make this generally possible will come later. They have only to note what has been done on the other side of the boundary, to realize that this is no impossible dream—merely something that has been delayed by an arbitrary line drawn from the junction of the Colorado and Gila rivers to the nearest convenient point on the Pacific coast.

However, it is unnecessary to rely upon prospective irrigation for dreams: there is something much nearer and more dazzling. Possibly, if you were where

Mountain Girls at Cabin Door.

A Mountain Ranch House

found are likely to be fractured and unmarketable. Therein would seem to lie much of the fascination of the quest: you have your hand always almost upon the wealth that lies in the mountains, and you know that others have reached that wealth. It is there — gold, silver, many varieties of precious stones, copper, iron, tin, lead, mica. There are marble quarries and onyx quarries, and, on islands near the coast, salt deposits and pearl fisheries. Lower California gems are being shipped constantly to the London market. Knowing this, the finding of a few stones of value easily leads one to think that a fortune lies just a little ahead.

you could find gold in the sand that you scooped up in your two hands, you also would indulge in dreams. You might go about the realization of those dreams in a little different way; but that is largely a matter of temperament. Possibly, if you found a gem of value among the loose stones and broken rock of a barren mountain (as I did at Jasay), you would begin to understand the optimism of those who live, or have interests, there. But the gold may not be in sufficient quantities to be taken profitably without a large preliminary investment in machinery, and most of the gems so easily

My experience at Jasay gives a fair insight into, and understanding of, the dreams and disappointments of certain kinds of gem mining. The Jasay mines are owned by Eduardo Roderiquez, of Jasay, and Riall & Baldwin, of San Diego. I give Roderiquez first place in the combination, because he stays on the ground and sees to the actual work of mining; and a man who has to live as he does is certainly entitled to this slight honor. I went with Roderiquez from his

A Mountain Stream in the Dry Season

cabin, something over 5,000 feet above sea-level, to his mines, a little higher up. It was all sage, sand, and rock here—desolate and unpromising—but I noticed that Roderiquez lagged a little, with his eyes on the ground, and occasionally picked up and examined pieces of stone and rock. Your true prospector is always prospecting. I followed his example; but, knowing nothing of precious stones, I picked up anything that had the color to catch my eye.

"What is it?" I asked, showing him a reddish stone.

"Hyacinth," he answered quietly.

Now, the hyacinth may not be generally known in the East, except to lapidaries and jewelers; but it is listed among the precious stones, has a value of from $10 to $50 a carat, and there is a ready market for the uncut stones in London and Amsterdam. It ranks with the diamond in luster ,and is next to the topaz in hardness. This I knew—and I had found one among the loose stones of the mountains.

"How much is it worth?" I asked.

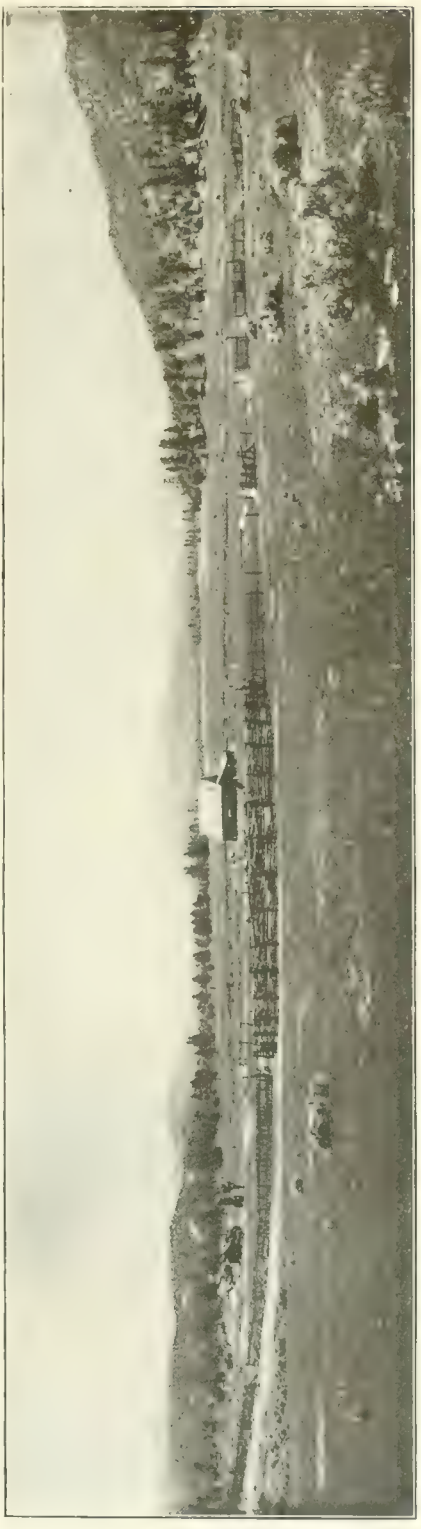
"Nothing," answered Roderiquez. "Air bubbles in it."

In a minor way I was experiencing the sensations of the prospector, and I felt the tingle of the fever. That stone might be valueless, but the very fact that it was there at all seemed proof of the presence of stones that were not valueless. I certainly could not overlook such a chance to pick up money.

The next stone proved to be a hyacinth, also, but it had too many fractures to give a clear piece for cutting. Then I tried a stone of another color.

"Tourmaline," explained Roderiquez. "Throw it away. I have picked up half a ton of them on one slope here, but I have yet to find one that is fit for the market."

And so it went on. There were surface indications of the presence of many kinds of precious stones; but, so far as perfect stones are concerned, the hyacinth alone has been reached at Jasay. I say "reached," advisedly, for the mining here has been of the primitive kind, and very little has been reached that is not close to the surface. Indeed, it is difficult to go deep, for almost everywhere there are rock ledges to bar the



TRES POSOS VALLEY FARM LOWER CALIFORNIA, 3,000 FEET ABOVE SEA-LEVEL.

[illegible]

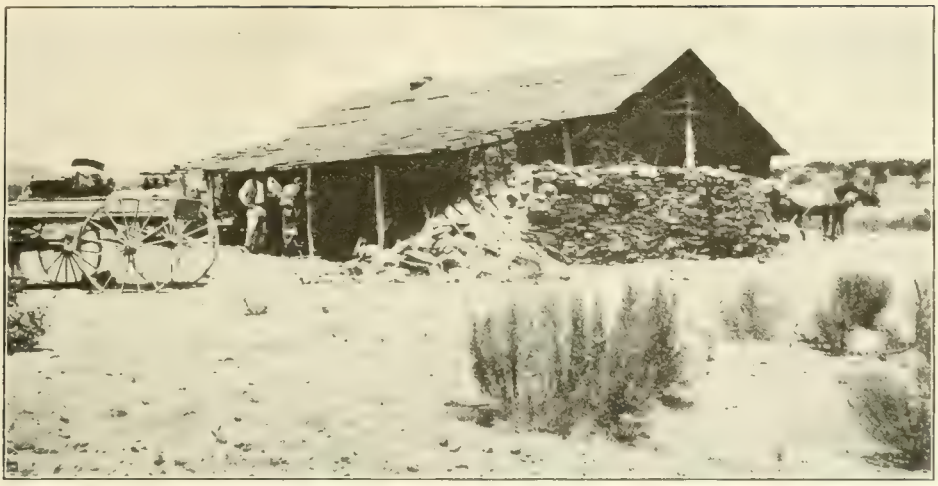
way. But the point I wish to make is, that the profusion of these imperfect stones gives a basis for the dreams of future wealth. These surface stones, crushed and broken and chipped away from the formations with which they naturally belong, the result of some great natural upheaval, are in the nature of guide-posts. Somewhere near, it is reasoned, there must be the conditions that give the perfect stones; but that "somewhere near" is an elusive place, and it may be a very costly one to reach. It may be straight down, or it may be in almost any direction except up. But the search is a fascinating game, giving visions of fabulous wealth, and, meanwhile, there is enough to give encouragement.

After I had found one stone that had a real market value, I wanted to keep right on hunting. To add to the allurement of surface indications, there is the knowledge that many varieties of gems are found and that the volcanic nature of the country will explain the presence of almost anything in this line. What you find near the surface is what has been forced up with the rocks; deep down there surely must be far finer specimens. There is also the record of success in other localities to urge one on. The zircon, jargoon, beryl, many varieties of the garnet group, turquoise, jasper, epidote, rose quartz, etc., are found, and—whisper it—a blue clay, said to be identical with the blue clay of the South African diamond fields.

"We'll find diamonds here yet," a prospector tells you confidentially; and one is inclined to think that the forces that have thrown up these mountains, tossing and grinding huge rocks, may have turned out almost anything in the process.

Is there not enough in all this to feed the dreams of the average man? Many have "gone broke" in the search for wealth, but many others have prospered. Transportation is so difficult, except along the coast, that much is added to the expense of any operations; but, in the more accessible localities, wealth is com-

AN IRON MINE IN THE MOUNTAINS, LOWER CALIFORNIA



CHEESE STOREHOUSE ON RANCH OF SEÑOR RODERIQUEZ, LOWER CALIFORNIA.

ing out of many of the mines, and, near the coast, irrigation has been tried and has proved the promise of the soil. Practically, however, the surface of the country has been only scratched here and there.

But, aside from the mineral and agricultural wealth, there are other opportunities for dreams. The true Lower Californian boasts of the climate as well as of the more tangible resources of the country. It may surprise those who have always associated it with torridity, but Ensenada feels sure of a future as a health and pleasure resort, and there are similar hopes and expectations all along the west coast from La Paz to Cape San Lucas. Ensenada already has a hotel overlooking the ocean, and boasts of tennis courts and golf links. The southern district, of which such great hopes are entertained, has nothing in the way of a pleasure resort hotel as yet; but you are assured that there will be one before long, and, meanwhile, "the Mexicans are a most hospitable people." Possibly, however, your idea of a pleasurable outing does not involve boarding with a Mexican family. In that case you would better wait a little while before seeking resort pleasures south of Ensenada. Possibly, too, you have reasons for wishing to keep in touch with the rest of the world. In that case, even Ensenada might not prove satisfactory. It is the most easily and comfortably reached by steamer from San Diego, although the trip may be made by stage. Before it eclipses Coronado Beach (which is one of its dreams), there will have to be decidedly improved transportation facilities. This is conceded, and you are regretfully informed that they would have those facilities now if Uncle Sam had not overlooked the country. Later they will come, you are assured, and Ensenada will be a fa ous winter resort, from which all sorts of interesting excursions may be made. Lower California boasts of mud volcanoes; and there are medicinal springs and sulphur baths and pretty nearly everything in the natural freak line.

LOWER CALIFORNIA BELLES.

Development has been fairly rapid of recent years, largely owing to the efforts of the Lower California Development Company; but this company's sphere of influence does not extend from the coast, and its boats make regular trips only about half way down the peninsula. Six trips a month are made to Ensenada, and two to St. Quentin, the onyx quarries, and Cedros Islands. This is all that the traffic now warrants; but, of course, the water transportation facilities will be increased as rapidly as there is need of it.

Back from the coast, there are only the stage lines, and even these reach comparatively few localities. There are mines of one sort or another everywhere; but only where exceptional success or the investment of money to do work on a large scale have brought together many people, do the stages come. The roads are difficult, and frequently great expense is involved in getting supplies and machinery necessary to do the work in any but the most primitive way. This unquestionably explains many of the failures. However, development is now progressing along sane, sober lines, in spite of the dreams, and the real wealth of the country will be uncovered gradually but surely. The opportunities are there; and, while Uncle Sam's oversight has unquestionably retarded progress, his people are now doing the best they can under existing circumstances. They supply the energy that the native Mexican usually lacks, but the Mexican himself is likewise doing much for the country.

## How to Do It

TO make a modern magazine,
Take, say, three hundred pages;
Fill three of these with photographs
Of grafters, statesmen, sages;
Of sonnets, here and there, use one
To finish up a page,
And devote full twenty pages
To the people of the stage;
Three very short stories—
Motor car in every one—
Fill the rest with advertising,
And your magazine is done.

# Passing the Fire Test

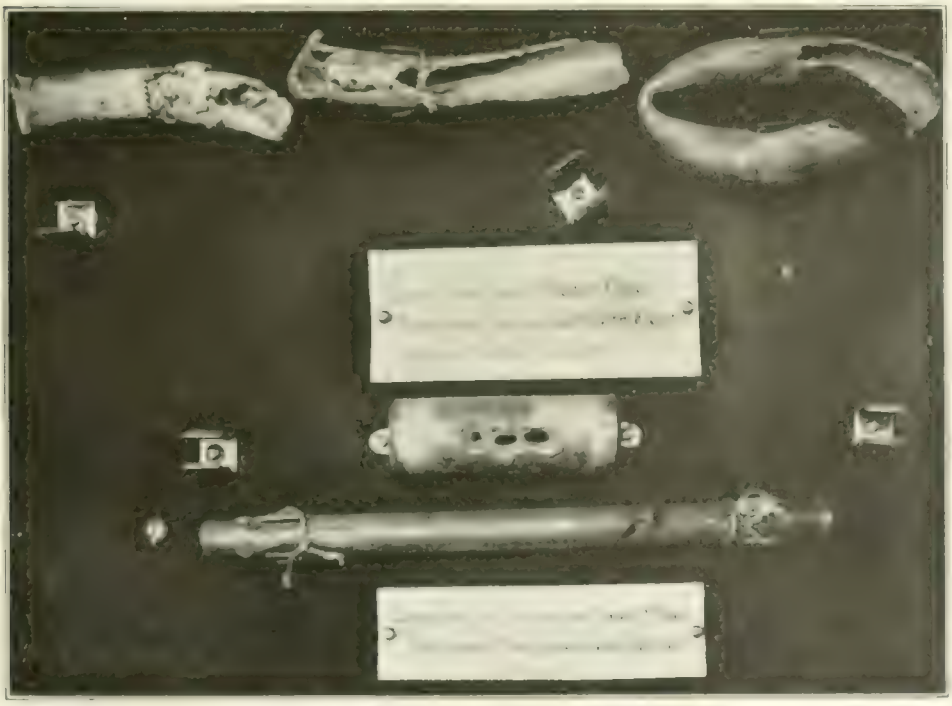
## By Hollis W. Field

LAST year the fire losses in the United States were $175,000,000. And there was no one great loss, like that in the $77,000,000 fire in Baltimore, the year before. Small wonder, then, that the insurance companies, on whom falls the chief burden of this loss, have at last seen the wisdom of establishing a laboratory in which fire as a destructive agent, and new methods of preventing its ravages, may be studied from a scientific standpoint.

In an indestructible building from the point of view of the fire hazard, with the furnishings and fittings of sheet steel, so that not enough wood might be gathered from it for building a fire in a kitchen stove, this Underwriters' Laboratory stands in East Ohio street, Chicago.

How much it is needed may be further gathered by a glance at the table which shows the number of public buildings destroyed by fire in the United States during the past three years:

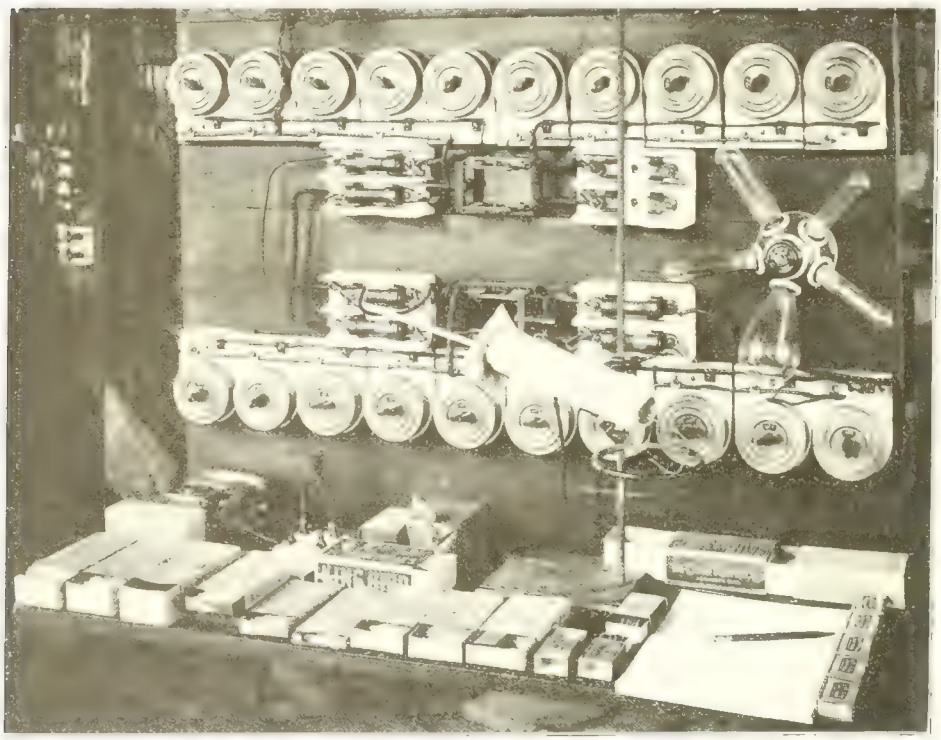
| | |
|---|---|
| Hotels | 1,162 |
| Churches | 1,821 |
| Schools | 1,582 |
| Halls | 544 |
| Hospitals and Asylums | 477 |
| Theaters | 427 |
| Colleges | 312 |
| Libraries | 45 |



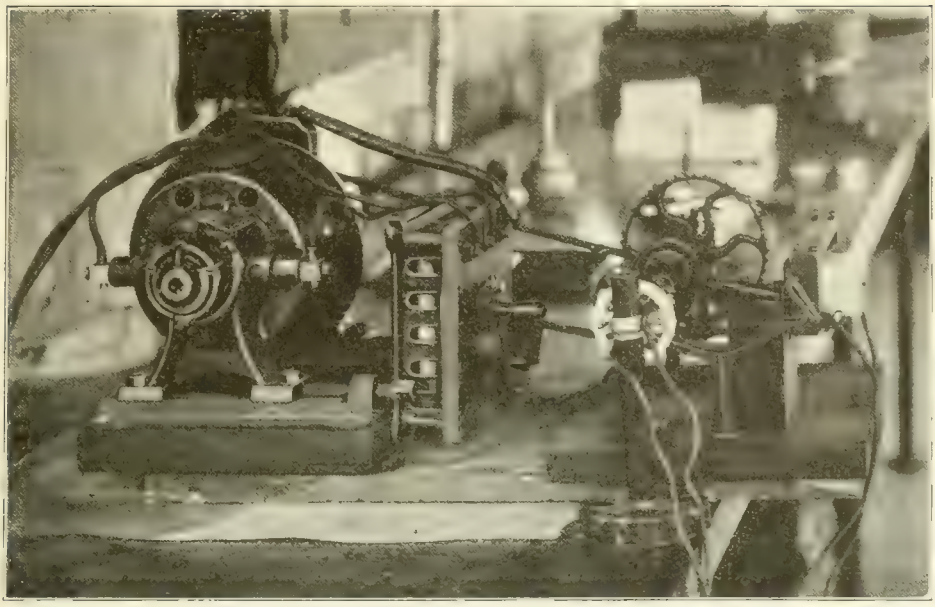
How not to have these tremendous financial and sociological losses is easy in that one moment when all architects and all builders of whatever degree decide to use no inflammable material in construction. When every building in Chicago is of the material of the Ohio street laboratory, the fire department can be dismissed. But this philosophy is too well worn—when every person in the same great city has come up to the moral standard of the best man in it, the police department also may be dispensed with! So it is that the new Underwriters' Laboratory to-day is more necessary than ever such an institution has been before.

Few of the great revolutionary inventions of men have failed to carry in their wake of good a train of ills as a part of the law of compensation. This has been more true of electricity, perhaps, than in the harnessing of any other of the forces of nature. To-day, in the minds of the laymen, electricity as heat is one of the least considered of the phenomena of that indispensable force. The average person, turning the electric current into an incandescent bulb, says to himself, "Ah, what an excellent light!" As a matter of fact, however, he has 90 per cent more heat than he has light, while with the calmest assurance in the world he may put this nineteen times as much heat as light into the inflammable draperies of a Christmas tree and be horror-stricken when the tree bursts into flame!

In a hundred ways the electric current, as it is directed into and through almost every building where man sets foot, has become the incubating source of destructive fires. Working with material fire, man sees to it that inflammable substances are kept clear of it. Working the light and power of electricity, he frequently brings the electric torch into the powder mill of his tinder construction with far more simplicity of misunderstanding than little Hoti showed when he burned his ancestral Chinese home in



MATCHES OF VARIOUS MANUFACTURE PURCHASED IN OPEN MARKET TO BE TESTED



MACHINE FOR TESTING PUSH AND KEY ELECTRIC SWITCHES
A cyclometer device records the number of times they are opened and closed, the action being accomplished through aid of a small electric motor.

order that he might enjoy the forbidden roast pig.

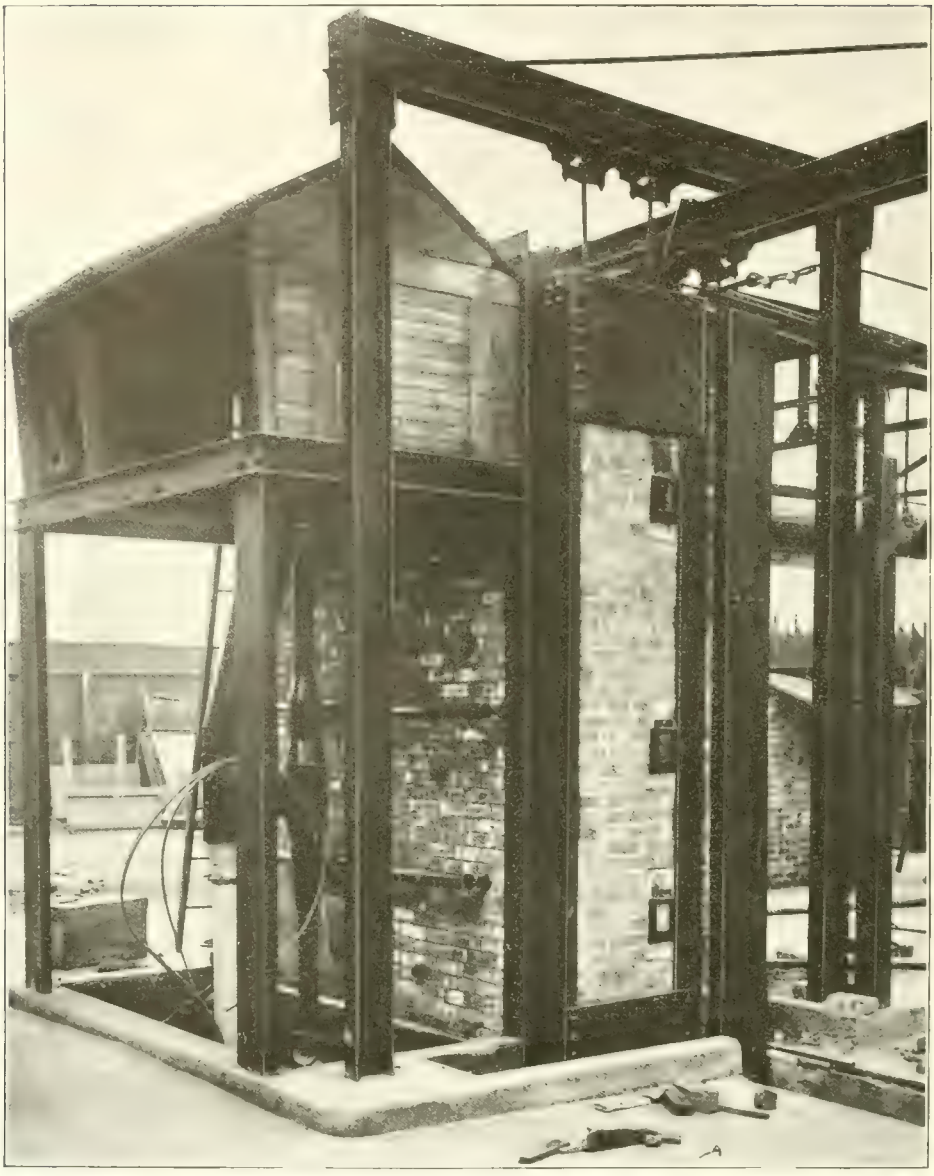
No other source of destructive fires receives the attention of the laboratory to such an extent as electrical conduits and connections. When a man enters his dark house and twists the hard rubber button on the wall in order to light a bulb or group of bulbs at the ceiling, he has no thought that right at his hand may be a deadly source of fire. Yet this snap-switch in the wall is searched into and tried and tested as few things electrical are.

A good snap-switch of the kind should be capable of 6,000 effective movements, off and on. This would mean that a house, equipped in the beginning with standard switches, should give no concern to the builder for perhaps ten years. But cheapness is ever a temptation; and without intelligent supervision the mere switch in the wall, close to a background of wooden-lath studding and paint-filled weatherboarding, may be a fire menace within thirty days or thirty minutes without the person most concerned having given it a thought.

One of the most interesting processes of the laboratory is that shown in a little electrically-driven engine which hour after hour effects the turning off and on of one of these snap-switches under test. Beyond the switch is a battery of electric bulbs responding with light and dark as the button moves; and no manufacture of buttons which do not give the 6,000 responsive minimum is passed as safe and certified to the National Board of Fire Underwriters.

Wires and their insulating wrappings are submitted to ordeals which ten years ago might have been regarded by the electrical engineer as unnecessary. Acid solutions are fixed, in which sections of insulated wire are left for days in the effort to discover defects in the insulation. And when the acid tests have been withstood, the wire may be subjected to electric loads far beyond those which intelligent engineering would have expected of them. The break-down test for these wires may be as high as 40,000 volts; and one of the significant sights of the laboratory equipment is a wooden block, four feet long, having an insulated channel cut its length, in which are the fused copper remains of many a bit of wire which failed of the work for which it was designed.

Along this line of test, also, is the cut-out switch, which reposes almost every-



A TESTING KILN.
For testing fire walls, fireproof doors, wire glass, etc.—The end of the kiln is supported by pulleys overhead, and is moved aside to admit article to be tested. Gas and air are then forced in; and careful record is made of the length of time of test, temperature, etc.

where just inside the electric meter in a building. Under modern construction this lever cut-out reposes in an asbestos-lined box, stopping the current in a moment from radiating through a building. Laboratory tests have shown that in this cut-out switch—in spite of the asbestos lining for a wooden box, fast to a wooden partition—the inability of the switch to carry the load from proper wires to proper wires, has been the source of destructive fires.

A glass front cabinet on the wall of the laboratory may be looked upon as the laboratory's chamber of horrors. In it are dozens of specimens of fused electrical cables and mechanisms to which have been traced costly fires. There are

examples of criminally deficient manufactures which have carried fire menace in their use. And not the least of the showings are those of water pipes and gas mains that have been destroyed by the insidious action of electrolysis.

To show how laboratory methods may work, there is on exhibition a type of porcelain insulator for telegraph and electric wires, made of the ordinary white clay, and of a mushroom shape, promising to fill the purposes of such pole devices in the highest efficiency. But under the scrutiny of the laboratory, the design and the material have been repudiated. The reason for the finding is that along the lines of the steam roads a great deal of carbon in minute particles is carried into the air from the smoke of locomotives. The hooded cap for the insulator, because of its size and its material substance, catches the carbon particles and holds them in the form of an incrustation which at once destroys the effectiveness of the insulators.

How possible fires may not spread, is another branch of laboratory research. The connecting door always has been a problem. If of steel heavy enough for fire protection, it is too unwieldy for general purposes. One of the forms of door intended for lightness and effectiveness at the same time, contemplates a thin veneering of metal, with a reinforcement of wood. But to serve their purpose these doors must be of proper material; and to prove this effectiveness such doors must stand not only heat but water. An interesting device has been installed by which to make this test.

In the yard outside, an oven has been built, into which immense gas burners have been led. On three sides of the oven are door apertures of standard sizes, to be closed in by the types of door under test. These doors are closed and fastened against the tremendous blaze of the gas, until the heat test of 1,600 degrees is satisfactorily withstood. Then the superheated doors are flung open, and water from hose nozzles is thrown against them with the force generated by the average steam fire-engine. On the results of these ordeals depend the passing of these doors to the satisfaction of the insurance underwriters. The "fireproof" glass for windows must show satisfactory results under similar conditions.

Woods that are in question are tested in the laboratory, and a careful report upon them tabulated. Fireproof paints are subjected to all possible conditions of fire. Roofing materials must undergo a thorough examination and test before a building covered with a material becomes acceptable to the National Board at acceptable rates.

The sprinkler system of fire protection, of which so much has been said, for and against, occupies a marked place in the testing laboratory. Where laws and ordinances have required the system in certain classes of public places, one of the hardest points to settle is that which the property owner brings up, claiming that while the sprinkler system may reassure the public and the insurance company in a possible unexpected emergency of an hour, the water in storage for this emergency is a menace to the insured for 365 days of the year.

The manufacturers of this system have been between the two fires of making the public and the companies secure in the one emergency, and at the same time of trying to make the insured one as secure as may be against the damage of accidental discharge of the water. Naturally, from the underwriter's point of view, there is a danger that the security from water may be accomplished through the manufacturers turning out sprinklers whose fusible release-metal will not melt at the low degree of heat making them most effective.

In the laboratory is a machine for the testing of this fusible plug. In this tester, heat is generated gradually, and is registered accurately by a thermometer extending from the heat chamber. Unless the fusible plug melts at the required temperature satisfactory to the National Board, the manufacturer of the sprinkler system needs to busy himself with a new mechanism.

As one of the forms of protection against water in the sprinkler system, the dry-pipe valve is permitted, especially in such places as water in the pipes would be likely to freeze. To insure the dry pipes, the ramifications of the pipes through a building are pumped full of air at such a pressure as to keep the wa-

ter below the first sprinkler in the chain. To do this, each sprinkler head must be air-tight as well as water-tight, standing the pressure test as well as the fusing test. When the sprinkler heads are passed, the automatic valves are then subjected to scrutiny. These valves control the water pressure, and not till, from whatever cause, the air escapes from a sprinkler, does the water rise to the point of sprinkler delivery.

In cities where they are installed, a further protection for underwriter and insured alike is the automatic alarm systems. Through these alarm stations, any disturbance of the air or water pressures in the pipes gives instant alarm at the watch office. This signal is at once a fire alarm in full effect. Devices which are to record these disturbances are as carefully tested in the laboratory as are any of the other mechanisms of the sprinkler systems.

Hose nozzles, rubber hose, and even the yarn covering fire hose, are inspected in every detail. The threads that are to be woven as a coating for hose are placed in a machine in yard lengths; and with a registering dial, are subjected to a breaking test before being passed. The chemical fire-engine is an object of much concern, not only for its chemical, fire-killing contents, but for its proper lining and capacity for standing the strain of its contents. Most of these chemical solutions must be held in a lead lining, and this lead sheet must be up to the last requirement.

The whole scheme of this unique laboratory puts it in a place that is as unique in commercial life as the laboratory itself is unique in conception and material execution. Under the written laws governing fire protection, it is assumed that inspection shall take the initiative of inquiry and aggressive oversight. The position of the laboratory is that the manufacturer of fire-protecting and fire-fighting apparatus seeks to obtain its official commendation of his product. Without this seal of effectiveness, any such manufacture is, at the least, questionable; while, if it has been submitted for approval and has failed to pass muster, the thing is outlawed so far as the rules and regulations of the National Board are concerned.

In the decisions affecting all such apparatus, the laboratory heads are supposed to be without shadow of bias. They

CABINET OF CHARACTERISTIC ELECTRICAL BURNOUTS, SHOWING CAUSES OF FIRES.
In office of Underwriters' Laboratory, Chicago.

THE CONSTRUCTION OF THE DESKS IS ENTIRELY OF METAL.

are the official representatives of the National Board and installed by it. But in some of the departments—as in the electrical and gas and oils tests—committees are charged with the work of considering the expert findings.

In this Underwriters' Laboratory the building itself—of steel construction, fireproof brick, terra cotta, and cement—is a lesson in fireproof construction. Even the roll-top desks are of smooth sheet steel, and the doors, window-frames, stairs, and railings of the same material. The only wood in its construction is in the 50,000-gallon tank in the basement, and this is kept full of water. A million closely built buildings of the kind, each twenty stories in height, could not make a conflagration.

But though the building itself may well serve as an example, it is from the labors of the corps of experts which it houses that civilization may expect the greatest benefits—a civilization which has suffered far too long from its own carelessness and from the criminal greed of the manufacturer and builder.

### Not His Way

JUSTICE (sternly)—"You are charged with stealing nine of Colonel Henry's hens last night. Have you any witnesses?"

BROTHER SWAGBACK (apologetically)—"Nussah! I s'pecks I's sawtuh peculiar dat-uh way, but it ain't never been muh custom to take witnesses along when I goes out chicken-stealin', sah." —*Puck*.

THE OLD AND THE NEW.

Motor-truck and horse-drawn vehicle arriving at railroad depot, loaded with six tons of merchandise. Horse truck at left.

# Motor-Trucks Driving Out Draught Horses

## By David Beecroft

THE maxim, "Man should never be required to perform those tasks that can be done by machinery," should be extended in these opening years of the twentieth century, and written, "Man and beast should not be required to perform those tasks that machinery can accomplish." Less than five years ago the adaptation of this maxim to the equine began; since then it has grown immeasurably, and the future is a vast, unbounded field to which the adaptation is specially suitable. With the opening years of the century the automobile builders abroad, particularly in Great Britain, conceived the idea of harnessing the gasoline and the electric motor to the big city truck, and using the mysterious electric current and gasoline vapor for propelling these monarchs of metropolitan transportation through the busiest arteries of the city's mercantile sections.

Preference rested with the electric motor, partly through the state of perfection it had reached on the trolley-car, and also because of its successful adaptation to the pleasure carriage. It was alone for but a short time, however, for contemporaneously with the advent of the gasoline motor in the automobile field came the trying of this type of motor on the big five- and seven-ton trucks that three and four horses had for centuries dragged through the crowded thoroughfares. As the diamond in the rough, so were these pioneer commercial automo-

biles. Engineers familiar with the best designs of horse-drawn trucks, found themselves on unknown ground when designing the self-propelled machine. Breakdowns followed in rapid sequence; discouraged purchasers consigned their dear-bought vehicles to the scrap pile; the horse was reinstalled and the motor-wagon ridiculed. Civilization, however, will advance; the best will out; and, in spite of engineers' failures and purchasers' condemnations, the motor-wagon grew in popular favor, and improved in strength and reliability, until it is now in England and France the undisputed master of the freight transportation question for every great metropolis.

America, slightly behind European countries in the art of automobile manufacture, was a year or so late in the introduction of the motor-wagon into city freight hauling; but what Columbia lost in time, she is now striving to make up in continuous energy; and if American push and brains can win, then the time is not far distant when the streets of our great cities will be in the hands of the commercial motor-wagon.

Already the conquest is assured. In the streets of New York, the five-ton electric and gasoline truck transports the tons of coal sold by many of the big dealers; grain merchants use the lordly electric for hauling from the depot to the warehouse; wholesalers have installed both gasoline and electrics for conveying goods from the warehouse to the retail headquarters; contractors use both for hauling building materials; electric light companies use them, the Edison Company alone requiring fifty in its employ; breweries are specially suitable because of the advertising value connected with them; and the myriad other Gotham concerns are getting interested. Coming west, Philadelphia has them by the score; Pittsburg, with its hills, is rapidly introducing them; Washington has a few; and Chicago, with its poorly paved streets, has a score or more of them in operation. In the West, Denver and Kansas City are following the example set by the East; Omaha has its first one; Salt Lake City has a couple; Minneapolis has three; and a dozen or more are in use in the various coast cities of California.

Motor-trucks are being used, because by them manufacturing and other concerns can transport their goods through the city streets cheaper than by horse labor. The factory magnate views the motor-wagon only in the atmosphere of

GASOLINE FREIGHTING TRUCK WITH 8-TON LOAD.
Small electric truck in right foreground.

dollars and cents; if cheaper than the horse, it is accepted; if more expensive to operate, it is discarded. In spite of it still being in its swaddling garments, it is proving itself a juvenile wonder, and is daily supplanting the horse in the many avenues of haulage.

Electric trucks in America, as abroad, received first attention. The five-ton

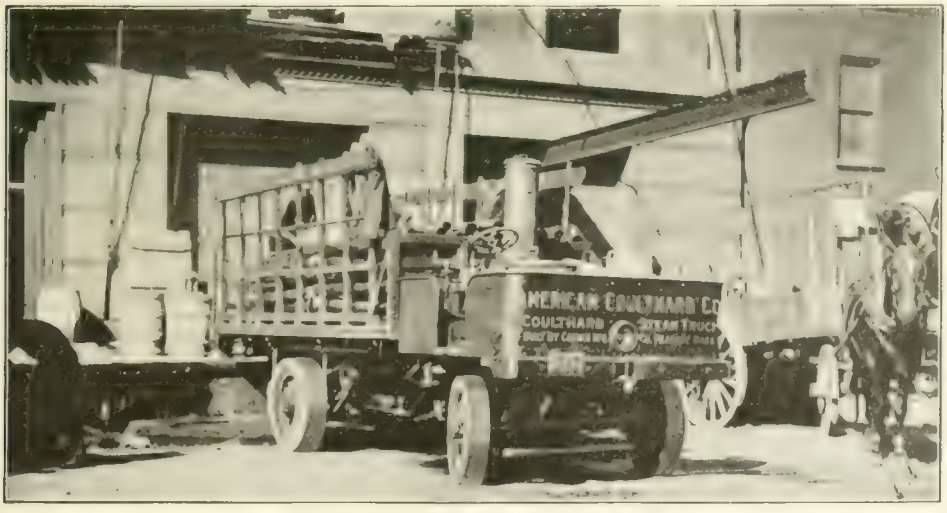
GASOLINE TRUCK WITH 2-TON LOAD OF LIGHT MERCHANDISE

vehicle of this class—that is, the truck capable of carrying this useful load—is a vehicle weighing itself when empty approximately this amount, making its total weight ten tons. Its motive force rests in an electric storage battery of, generally, forty cells, carried midway between the front and rear wheels and suspended from the under side of the car frame. This battery has a sufficient electrical charge to carry the truck with load from twenty-five to thirty miles, after which time it must be recharged from some electric source, six to eight hours being needed in recharging. This fact greatly hampers the usefulness of this type of truck. Owners of such have them recharged overnight, to be in readiness for an early start next morning; but in many businesses the thirty-mile charge is not sufficient for an all-day run, particularly as the truck can travel ten miles an hour, meaning but two and a-half or three hours of continuous running. In spite of this restriction, however, the electric truck is popular with many classes. Simplicity is its merit. The purchaser of this type of truck can take his horse driver, and in a day graduate him to the rank of chauffeur. All required is to learn how to steer the machine, to apply the brakes, and to work the controller handle by which the amount of electricity going to the motors is regulated and so the speed of the machine controlled. These three duties are soon learned. The truck is, in short, but a battery and one or two electric motors. The battery requires expert attention,

and is generally cared for by a specially engaged electrician where the concern operates several trucks; where a concern operates a single truck, the battery care is intrusted to the garage owner or superintendent where the truck is stored at night. The motor is perfected and rarely needs attention. Consequently, were it not for the mileage limitation, the electric truck would be the ideal machine. It can exert its full power at a snail's pace; when ascending a hill, a heavy overload of current can be taken from the battery, or, in getting out of a hole, full power can instantly be thrown on.

A 3 Ton Truck Loaded with Paper for Newspaper Office.

Compared with the electric truck, the gasoline vehicle possesses the one great advantage of having an unlimited mileage. With it the driver can travel from six in the morning until ten at night, the only essential being a few gallons of gasoline, which can be obtained at many city points. But while unlimited mileage has been gained, the gasoline truck has its very prominent disadvantages. The gasoline vehicle is complex, and requires expert attention when on the street, as well as when being repaired in the shop. It combines a gasoline engine operating at 1,000 revolutions per minute; a vapor-forming device that mixes gasoline with pure air in proportions to form a powerfully explosive mixture; an electric system for exploding this mixture in the cylinders of the motor; a clutch by which the motor can be run without the car moving; a transmission gear allowing of the car traveling at different speeds; and a method of conveying the power of the motor to the wheels of the vehicle. All of these parts must be carefully cared for, inspected, and repaired. Besides this, the machine has to be guided on the streets, brakes applied, and the motor speed and speed changes acomplished.



STEAM TRUCK WITH 7-TON LOAD.

These manifold duties require brains as well as expert training.

Such duties suggest the great question of securing drivers for gasoline machines. As well place a railroad locomotive in the hands of a novice as the gasoline truck in the care of an incompetent. He will in a few days run it to its own destruction. Drivers have to be educated. This is best done by taking a horse driver and having him serve an apprenticeship of a month or six weeks in the factory of the car he is to operate. During this apprenticeship he passes through every department of the factory; sees the many parts that when assembled form the completed motor-truck; actively engages in putting these parts together; effects ordinary repairs; drives a truck for a short time each day; familiarizes himself with the electric system; and, in short, becomes a fair amateur expert on the rudiments of the machine he is to drive. Chauffeurs from pleasure automobiles have been tried as drivers of commercial trucks, but they have proven failures. They drive too fast; the rough streets shake the ponderous trucks to pieces; repairs rise apace; and the economy of the vehicle is destroyed. These drivers are not familiar with the ins and outs of city draying, and generally run contrary to the wills of the horse teamsters, thereby working ill to their employers' interest. Automobile schools have been established in many of the leading cities, and at these the amateur can learn the art of driving, but the results are not so pronounced as where a visit to the factory is made.

GASOLINE TRUCK LOADED

There is but little difference in cost in the installing of an electric or a gasoline truck. There are on the market at present American-built electric trucks for carrying five tons, that cost $4,000 and $4,500; and gasoline trucks carrying the same loads cost practically the same, while gasoline trucks for six and seven tons cost $5,000 and $6,000. The cost is generally about $1,000 per ton load. A seven-ton gasoline truck now in the service of a large mail-order house in Chicago, averages forty miles per day, a distance almost three times that averaged by horse-drawn trucks. Fifteen gallons of gasoline are required per day, which, with gasoline costing eleven cents when purchased by the barrel, brings the cost of fuel to $1.65 per day. Lubricating oil costs 25 cents, making the daily cost of operation $1.90, $11.40 per week, $49.40 per month, or $592.80 per year. This fuel consumption is a fair average for machines of this type carrying loads often in excess of seven tons. The cost of electricity for a similar truck varies considerably according to the firm operating it. Should the concern be a large user of electric current, the price would be low; if the owner has an electric plant of its own, the cost is still lower, but should it have the charging done at a garage it will be very expensive. Electricity is sold by the kilowatt-hour, the market price being 10 cents per kilowatt-hour. At this rate the cost of recharging amounts to $1.50 for 30 miles, or five cents a mile for current; whereas gasoline costs around three and a-half cents. Some large private mercantile concerns have their own electric plant, in which case the cost of electricity

is more than cut in half, and saving also made in other ways.

Compared with the relative cost of horse teaming, the differences appear. The gasoline or electric truck, if given the opportunity, can perform the work of three two-horse teams, and often more. Heavy horses cost $475 per team, wagons cost $800 each; and harness amounts to $50 per set—making in all a total of practically $4,000 for the three-team outfit. Keep and provender costs $36 per month for each team, making a monthly outlay of $108 for the three, as against $50 for the motor-truck. Three drivers at $12 per week are needed for the horses, making in all $36 per week, whereas one driver at $15 per week is six-, and seven-ton trucks. Rubber is expensive, each of such tires costing $135, and the set of four aggregating $540. The torque of the driving wheels eats this rubber up at a phenomenal rate, particularly if the driver follows the street-car tracks. A set of tires on a gasoline truck will, on the back or driving wheels, last four or five months with steady service, if the car is driven on the street-car tracks, and much longer if driven on the pavement, the car rails cutting the tires. On electric machines the same size of tires are used, but they last considerably longer on the rear wheels, as the power can be more gradually applied. On the front wheels of both kinds of vehicles, the life of the tire is double

GASOLINE TRUCK IN SERVICE.

Loaded with trunks weighing 5,500 lbs., making way through crowded alley

sufficient for the truck, meaning a weekly saving of $21.

The expense of up-keep of a truck is much in excess of that of horses and horse wagons. This is particularly true because of the cost of maintaining the motor-truck in tires. The ponderous machines have to use solid rubber tires, these tires being 7 inches wide on five-, this period. Experiments are now being made with the use of wood for these tires, and fairly good results are forthcoming. A company in Milwaukee, Wis., makes a seven-ton truck in which wood tires eight inches wide are used. These tires consist of blocks of hardwood placed radially so that the ends contact with the ground. Metal wedges are driven in be-

tween the blocks to increase their strength. Tires of this type are capable of wearing six months, and cost but $75 per set of four, but cannot be fitted to the ordinary wheel. They have the disadvantage of jarring the machinery considerably, the springs of the truck being the only agents to absorb the jar, which is most considerable when a fourteen-ton vehicle is traveling over a cobblestone pavement at ten miles per hour.

Next to the problem of tires is that of streets. The steam locomotive has provided for it a pair of steel rails anchored to a perfectly level roadbed; the commercial motor-truck is expected to travel over the cobblestone pavement, across cedar blocks, over rough crossings, and, in fact, every place where a horse wagon goes. It can do this, but not at fifteen miles an hour; it can travel over these places at this rate, but the machinery will soon be shaken to pieces. Shaking machinery means large repair bills; rough streets mean hard wear on rubber tires; and both of these items mean that the economy of the truck is vastly impaired. Good streets are essential, and without them the truck is robbed of its lifeblood. Brick pavement kept in good condition is best. Next comes asphalt, which, while smoothest, becomes soft in warm weather, causing the truck wheel always to be climbing a miniature hill. The wheel under the tremendous load constantly sinks in the asphalt, forcing it up in front and behind the wheel. Macadam affords excellent surface, but is generally in a poor state of repair and wears in holes. Cobblestones are the gravevards of the truck, as are the different types of block pavement. On a good street a truck can double its mileage every day and its lifetime is increased four-fold.

As to the endurance of the motor-trucks, definite facts are hard to obtain, and conditions vary so that generalizing is impossible. Trucks are in use in New York that have been in steady use for four years and are still good, whereas other machines of the same make have already been discarded. The life of them rests with the driver; according to his whims their days can be reckoned in years or months. If he plunges his machine over rough streets when heavily loaded, it comes to a premature end; but if he cares for it, crosses rough places slowly, and takes proper care of his machine, it will endure not five but ten years.

FIVE-TON ELECTRIC TRUCK.

Trucks must be cared for, particularly the gasoline type. Every night after the day's work is done, they should be examined, every part looked at to see if the adjustment is correct. Once a week, every Saturday afternoon, a regular cleaning-up is needed, when the parts should be cleaned and every one tightened. Lastly, once every two months the motor should be taken apart, cleaned thoroughly, parts worn replaced by others, and the whole adjusted. With this attention, the life of the truck can be made to compare with that of the locomotive that visits the roundhouse after every run of a hundred miles.

Though not primarily considered by prospective buyers, the municipal influ-

ence of the motor-truck deserves attention. A passing odor of burnt oil or smoking gasoline is its only disadvantage, and it disappears in a second. In horseless town the air will not be impregnated with animal impurities, nor will the coffers of the city be depleted by the "white wing" brigades. Viewed economically, the motor-truck bids fair to solve the congestion of streets in busy centers. The motor-truck carrying seven tons occupies less space than the two-horse team pulling but half the load. The four-ton truck requires but little over half the space of the two-horse team. From the point of view of speed, the truck averages double that of horse vehicles, which, combined with the space question, means a cutting of the congestion by four. Added to these advantages is the greater ease of manipulation, the truck turning in smaller spaces, and being stopped in half the distance needed for horse trucks. Not to be forgotten is the absence of noise. Motors are now being made to operate quietly; and this, combined with the use of rubber tires, permits the huge truck to travel much more quietly over the rough streets than can the light, iron-tired, horse delivery wagon.

With everything to gain and nothing to lose, the horseless truck is marching apace with the century. To-day it is the experiment of the few; to-morrow it will be the necessity of the many. Yesterday practically unknown; to-morrow administering to the needs of myriads.

### Cultivate Men of Purpose

THE business world is full of young men content in simply putting in their time somehow and drawing their salaries, making no effort whatever to increase their efficiency and thereby enhance their own as well as their employer's interest.

To every young man I would say, seek at the start to cultivate the acquaintance of those only whose contact and influence will kindle high purposes, as I regard the building up of a sterling character one of the fundamental principles of true success.

—MARSHALL FIELD.

# Making Silk Out of Gun-Cotton

By Clarence Hutton

SCIENCE, which lately furnished a mechanical substitute for the horse, has now set about putting the lowly silkworm out of business.

Almost unknown in the United States, the manufacture of artificial silk has been on a commercial basis in France for several years, the daily production being now about seven tons.

In forming a chemical compound corresponding to the viscous fluid out of which the silkworm spins his delicate thread, the French chemists found, strangely enough, that the best substitute was a solution of gun-cotton, which also serves as the basis for the most powerful and deadly of modern explosives. To what extent this gun-cotton silk is relieved of its explosive qualities before being woven into laces and dress fabrics, seems to be somewhat questionable. Certainly a young woman gowned in gun-cotton and wearing a dainty nitro-glycerine wrap about her white shoulders, would be a most formidable not to say dangerous object. If the new fabric ever becomes popular in this country it will plainly be necessary to warn young men not to approach its wearers with lighted cigarettes or other combustibles in their hands. And sparking will become a most hazardous occupation.

Natural silk—the product of the silkworm—is the most valuable intrinsically of the textile fibers, costing from seven to ten dollars per pound. Its value has led to numerous attempts to supplant the long, tedious efforts necessary for a silkworm to produce a few grains of fiber, by more productive if not more effective means. Silk, being an albuminoid matter, must be susceptible of synthesis—this was the theory advanced by chemists, which they sought vainly for a long time to establish as a fact.

It is many years since Réaumur, the French naturalist who was probably the originator of the synthetic theory conceived the idea of producing by synthesis a substitute for natural silk. We have no means of knowing whether Réaumur's motive was gain, or a desire to place the apparel of kings within the reach of the common people; and it does not matter—for he failed, and the silkworm continued to spin as slowly as before.

Réaumur's time, however, was not pregnant with the possibilities or the energy which characterize the present; and, moreover, he may have remembered the disfavor in which successful inventors of a century ago were held by their fellow men. In the last fifty years there have been several sporadic attempts to carry Réaumur's theory to a successful conclusion; but it remained, very appropriately, for another French scientist, M. de Chardonnet, to establish an industrial process and produce a commercial artificial silk. Other discoveries followed, until at present there are at least three distinct methods of producing artificial silk, which are competing with one another and with the venerable silkworm to supply the world's annual demand for 35,000 tons of silk textiles.

The founders of the new industry have kept in view, not so much the exact reproduction of natural silk, as the production of a substance which embraces its valuable properties. Natural silk possesses to a large degree qualities of brilliancy, elasticity, strength, affinity for coloring and bleaching materials, and a peculiar rustling sound, when handled, known as *scroop*. Perhaps the brilliancy and scroop of silk are the best known of its qualities; and it is in these two respects that artificial silk most closely resembles natural, its brilliancy being greater and

its scroop being slightly less. The other properties of silk are present in greater or less degree; but in tensile strength and resistance to moisture—two of the most valuable properties of any textile—the inventors have fallen far short of their object. Some kinds of artificial silk, also, are highly inflammable, which, in conjunction with other defects, renders their use impracticable for many purposes to which natural silk is peculiarly adapted.

A comparative microscopic examination of natural and artificial silks shows some dissimilarities in their physical properties, the natural silk being a double filament which has the appearance of two solid, cylindrical fibers. Artificial silk consists of a single, cylindrical-shaped fiber, although a number of these may be drawn together, as will be explained later. In other respects the appearance of the two fibers is very similar, the artificial in most cases being a trifle the larger. The specific gravity of artificial silk, averaging about 1.490, is greater than that of natural silk, which ranges between 1.357 and 1.367.

It is generally understood in a vague manner that textile fabrics are composed of "yarns," and that yarns consist of innumerable small fibers held together by a series of spiral twists. These fibers are obtained from some forms of animal, vegetable, and mineral matter, and all are synthetic substances formed in Nature's laboratory, and may be divided by analysis into their constituent elements.

Silk is an animal product which exists in the silkworm in the form of a viscous liquid. Upon being excreted from the worm in preparing for the chrysalis state, the liquid solidifies, forming a continuous fiber of from 1,200 to 4,000 feet, or even more, in length. In the process of manufacturing, these fibers are doubled to produce yarn of the required strength and bulk.

To show how closely the inventors of artificial silk have followed Nature's method as exemplified in the silkworm, Figs. 1 and 2 have been prepared. The liquid or substance from which the fiber is formed is secreted in a pair of glands shown in Fig. 1, which are symmetrically located along the sides of the body. The ends of the glands meet at the point *A*, which gives the double structural formation of natural silk.

In the artificial method, a quantity of cotton is cleansed of all impurities by washing in a solution of caustic soda and washing soda; then treated with cold, concentrated nitric acid or with a cold mixture of nitric and sulphuric acids, which changes the cellulose of the cotton into *tetra-nitro-cellulose,* commonly known as *gun-cotton.* This product is soluble in a mixture of alcohol and ether,

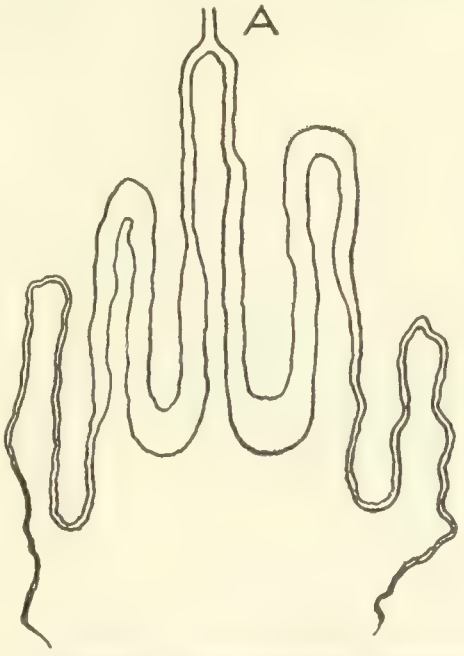



FIG. 1. DIAGRAM AT VERY LARGE SCALE ILLUSTRATING DOUBLE TUBULAR SECRETORY GLANDS OF SILKWORM.
The glands meet at *A*, thus accounting for the double structural formation of the silk fiber.

the solution being known as *collodion.* This substance corresponds to the secretion of the silkworm. Following Nature's plan, the solution is introduced into a receptacle from which it is forced by an air-pump through one or more fine, capillary orifices corresponding to the spinneret of the silkworm.

Fig. 2 shows the principle adopted in forming the fibers. The solution is forced through the tube *C* into the capillaries *B,* one end of which is closed, with the exception of one or more very fine holes, through which the solution is forced as shown at *F.* When two or more fibers are expressed from the capillaries, they are drawn together by capillary attrac-

tion, forming a structure similar to natural silk. The inner tube *C* is surrounded by a jacket tube *K*, through which there is a constant flow of cold water.

Immediately upon coming in contact with the cold water, the solution solidifies, then is dried, and wound upon reels to await its turn for manufacture into yarn. The interior pressure and the mechanism for withdrawing the fiber, are regulated in such manner that a uniform

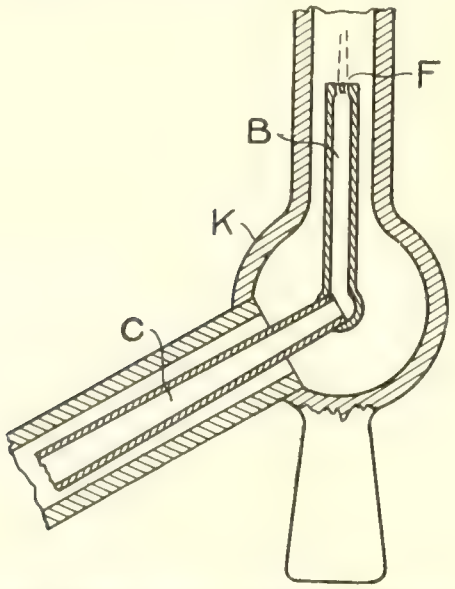



Fig. 2. Diagram Illustrating Artificial Method of Forming Fibers.

and brilliant thread of about the same diameter as that drawn from the cocoon is obtained. If the fiber obtained by this process is to be colored, the coloring matters are added directly to the pyroxylin solution. In this respect another difference between the natural and artificial fibers is noted, the former being colored after leaving the silkworm, as no successful method of injecting dyestuffs has been discovered. The necessity of adding the coloring matters to the artificial silk solution is caused by the slight resistance artificial silk offers to the destructive action of water.

The method just described produces an article which is quite inflammable; and to remedy this defect the fibers are treated with an alkali sulphide solution.

Other methods of producing artificial silk are the treatment of cellulose with copper hydrate, zinc chloride, or bisulphide of carbon; but the principle of forcing the solution through capillaries is common to all.

The consistency—or "viscosity," as it is technically termed—of the solution, is of the greatest importance, as it determines to a large extent the successful formation of the thread.

The process of mercerization, which was discovered some years ago, and which seriously affected some grades of silks, does not produce a fabric resembling artificial silk in any way. Cotton is mercerized after it is spun, by subjecting the yarn to tension in a caustic soda solution. The fact that the mercerizing process takes place when the material is in the form of yarn, precludes all possibility of a serious competition with the better grade of silk, as the mercerized fabric has none of the properties of silk except an inferior luster.

The possibilities open to artificial silk, on the other hand, are much broader, as it aims to produce a fiber equal to natural silk. A silk congress has already been called to meet in Turin, Italy, a silk-producing center, to investigate the serious inroads of artificial silk, and to decide upon some inexpensive test that will insure purchasers against the substitution of the artificial for the real article. This, however, is probably the frenzied action of those who will suffer by the development of the new industry, to whom each new development seems like the doom of natural silk and the mulberry-fed silkworm.

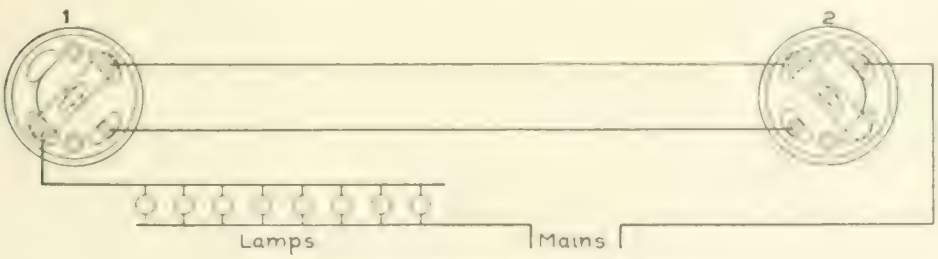
The future of artificial silk is, of course, a problem that only the future can solve; but it will undoubtedly replace natural silk for many purposes. Its inventors are not resting on the laurels already won; and work on its defects is progressing so rapidly that we may soon expect non-inflammable artificial silk as we now have non-inflammable collodion. The destructive action of water and the deficiency in tensile strength will also undoubtedly be corrected as the processes develop. With these improvements and a cost of about one-fourth that of the animal silk, the artificial product will probably become a much larger factor than at present in the world's silk industry.

*be sent by mail, provided a stamped and addressed envelope is enclosed with the question. Requests for information as to where desired articles can be purchased will also be cheerfully answered.*

### Control of Lights

*Question:* Will you kindly give me a plan [illegible] for a 3-way switch, by means of which [illegible] can be turned on by one pair of the leads and turned off by the other, or *vice versa.*—*W. C. L.*

*Answer:* The accompanying sketch shows the connections which you ask for; 1 and 2 represent the 3-way switches by means of which the bank of lamps can be controlled in the manner you suggest. With the switches in the position shown, the lamps will burn. If now switch 1 is turned through 90°, the lamps will be extinguished. If then, while switch 1 is in this new position, switch 2 is turned through 90°, the lamps will glow. In a similar manner the lights are under perfect control from either switch at all times.




[illegible]

### Boiler Test and Safe Pressure

*Question:* How is the safe working pressure found, and how is the boiler tested, data being as follows: Diameter of boiler, 60 inches; thickness of plate, ½ inch; tensile strength of plate, 60,000 lbs.?—*H. L. B.*

*Answer:* The safe working pressure is found by multiplying twice the thickness of the plate by the tensile strength in pounds, and dividing the result obtained by six times the diameter of the boiler, as follows:

$$\frac{1 \times 2 \times 60{,}000}{6 \times 60} = 166\tfrac{2}{3} \text{ lbs.}$$

The maximum test pressure is obtained by adding to the safe working pressure 50 per cent, giving in this case $166\frac{2}{3}$ lbs. + $83\frac{1}{3}$ lbs. = 250 lbs. Now, applying hydraulic pressure as high as the test pressure, will show that it is safe to run

the boiler at two-thirds of the test pressure if it goes through this test safely.

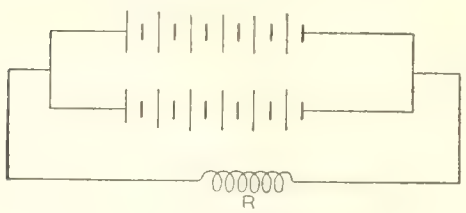
Before putting hydraulic pressure on an old boiler, empty the boiler; go over it carefully with the hammer for broken braces, weak and corroded spots; figure for safe pressure on the thinnest place found in the boiler; fill boiler full of cold water, and gradually heat it until the desired pressure is reached. By this mode of testing by hot-water pressure, the heated water is expanded, and is more elastic than when cold, and is not so liable to strain the boiler. Before allowing the pressure to be applied, see that the boiler is properly braced and stayed, and that the rivets are of proper size.

All flat surfaces, such as found in fire-box boilers, should have stays not over 5 or 6 inches apart, for all ordinary pressure, and boiler heads not over 7 inches apart.

On account of the loss of strength in the plates by rivet-holes, some authorities allow only 70 per cent of the safe pressure given above, for double-riveted boilers, and 56 per cent for single-riveted boilers.

### Computing Current

*Question:* Twelve cells, each having an E. M. F. of 1.5 volts and an internal resistance of ⅓ ohm, are joined in a mixed circuit of six cells in each of two parallel series. Compute the current through an external resistance of 3 ohms.—*W. H. D.*




Two Sets of Cells Connected in Series.

*Answer:* You would have an arrangement as shown in the accompanying sketch—namely, of two parallel sets of six cells in series.

In solving the problem, we use the formula

$$I = \frac{mE}{R + \frac{mr}{n}}$$

in which $m$ = Number of cells in series; $E$ = Voltage of one cell; $R$ = External resistance; $r$ = Internal resistance; and $n$ = Number of sets in parallel. Substituting, we have

$$I = \frac{6 \times 1.5}{3 \times \frac{6 \cdot \frac{1}{3}}{2}} = 2\tfrac{1}{4}.$$

Hence the current would be 2¼ amperes.

### Removing Rust—Driving Belt

*Question 1:* How can rust be removed from iron?

*Question 2:* Which side of the belt should be run next the pulley?

*Question 3:* Should driving motion of belt be with or against the laps of the belt?—*W. B. E.*

*Answer 1:* A method of removing rust from iron consists in immersing the articles in a bath consisting of a nearly saturated solution of chloride of tin. The length of time during which the objects are allowed to remain in the bath depends on the thickness of the coating of rust; but in ordinary cases twelve to twenty-four hours is sufficient. The solution ought not to contain a great excess of acid if the iron itself is not to be attacked. On taking them from the bath, the articles are rinsed in water and afterward in ammonia. The iron, when thus treated, has the appearance of dull silver; but a simple polishing will give it its normal appearance.

*Answer 2:* The grain (hair) side of the belt running next the pulley will give the belt about 30 per cent more power than if the flesh side is on the pulley.

*Answer 3:* Motion of driving should run with the laps of the belt.

### Size of Wire

*Question:* Please tell me the length and size of wire required in both primary and secondary coils of an induction coil to transform a current of 10 volts to a current of 110.—*J. M.*

*Answer:* We assume, since you speak of an induction coil instead of a transformer, that you have a direct rather than an alternating current. A direct

current could hardly be raised from 10 volts to 110 by means of an induction coil and be available for any practical use—such, for instance, as lighting incandescent lamps.

In the case of a transformer, in order to raise the current from 10 to 110 volts, you would need approximately 11 times as many turns on the secondary coil as on the primary, and the cross-sectional area of the secondary wire would need to be 1-11 as great as that in the primary. This would also be approximately true in the case of the induction coil, but the latter does not follow the laws of rational design as closely as the transformer, and frequently the calculated results when put into practice are found to be very far from exact.

### Use of Caissons

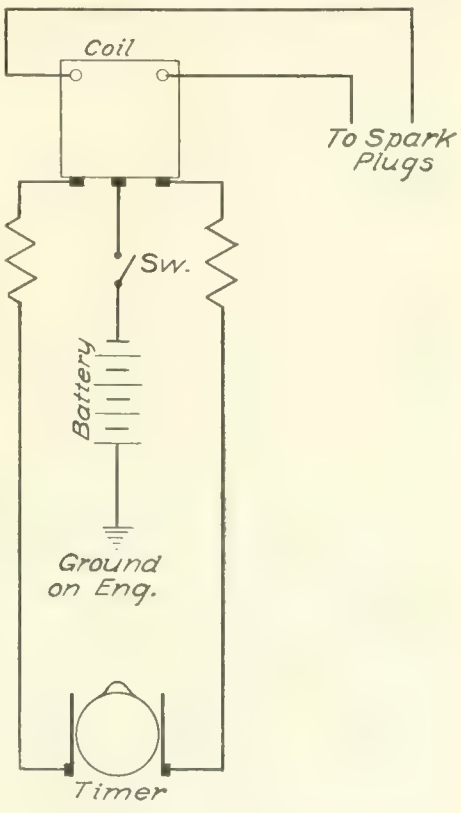
*Question* What are caissons used for?—*A. P. G.*

*Answer:* Where the soil is too yielding or the necessary area is not available, foundations are sometimes carried to bed rock. This is done by the use of caissons, which are sunk through the soft material to the rock. A caisson consists of a steel chamber, having the bottom edge extending below an air-tight floor far enough to form a working chamber into which compressed air is forced. This air keeps out the water and soft material, and enables the workmen to excavate and thus allow the caisson to sink to bed rock. The excavator material is hoisted up through air-locked shafts, and the masonry of the foundation is built within the caisson, helping to sink it down. When bed rock is reached, the working chamber is filled solid with concrete, and a solid foundation is secured. This is called the "plenum" or "compressed-air" process. Caissons are also sunk by the "vacuum" process, which consists in exhausting the air from the interior of the caisson, and allowing it to sink by the aid of the pressure of the atmosphere. By this process, the water is caused to flow under the lower edge of the caisson, loosening the soil and assisting the sinking of the caisson.

### Connections of Spark Coil—Motor Structure

*Question 1:* We have a double spark coil with binding-posts as per enclosed diagram. We want to wire it to a two-cylinder engine and use but one battery as in diagram. This forces secondary current to return to coil through battery. Will the passing of this current have any bad effect or shorten the life of the battery?

*Question 2:* Is there any structural difference between the ordinary direct-current motor and the one used on both direct current and single phase alternating current?—*H. L. B.*




Connections of Spark Coil.

*Answer 1:* The passage of the secondary current through the battery, as shown in your sketch, would have no injurious effect upon the battery.

*Answer 2:* There is no radical or fundamental difference between a direct-current motor and one intended to operate on both alternating current and direct current. The only difference is in detail. An alternating-current motor must have laminated fields and some means of compensating for armature reaction.

### Coking Quality of Coal

*Question:* How may the coking quality of coal be tested?—*L. L. W.*

*Answer:* Obtain a tin can (an ordinary Standard Oil can will do); fill it with pulverized coal which you wish to test; pack the coal in well; and place the can in a good coal fire for four or five hours. If the can holds together for that length of time, then remove and examine the product. This method should serve to prove whether or not the coal will serve for coking. A beehive oven is not necessary.

Instead of the can mentioned above, you may simply make a cone-shaped pile of coal, cover it loosely with cobblestones, and start it burning from below, keeping it burning until fusion of the coal in the top layers takes place.

### Short Circuit on Telephone Line

*Question:* Why is it that the bells on a bridging type of telephone will not ring if there is a short circuit on the line? This short circuit cripples the whole system, and it is almost impossible to turn the handle of the generator.—*N. L. J.*

*Answer:* In a bridging system of telephones, all the phones are, of course, connected across the line in parallel. Now, if there is a short circuit on the line, this also exists in parallel with the bridging phones. The resistance of the short is practically zero as compared with the resistance of the ringers; and consequently the short takes all the current so that none is left for the bells, which consequently will not ring.

The reason that it is difficult to turn the generator is that the short circuit amounts to a very heavy load on the line, consequently demanding a very large current from the generator, and the power to turn it must consequently be proportional to the current supply.

### Cyanide Case-Hardening

*Question:* Describe the process of cyanide case-hardening.—*M. L. G.*

*Answer:* For the cyanide method, cyanide of potassium is used—the purer the better. One way of using the cyanide is as follows: Small pieces, and pieces which need only a very thin shell of hard steel, are heated to a high red heat, drawn from the fire, and sprinkled over with cyanide of potassium, reheated for a few seconds to give the carbon from the cyanide a chance to "soak in," drawn from the fire again, sprinkled with cyanide, and cooled in cold water. This is an easy and quick way when it will answer the purpose.

This method is also of use when case-hardening in spots. When only a hole or some small part of a piece is wanted hardened, a small piece of the cyanide may be placed on that particular spot, and the hardening confined to the area covered by the cyanide.

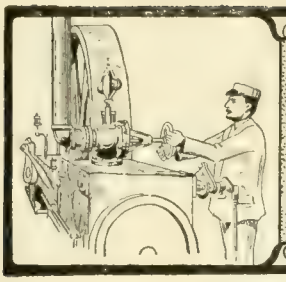
Another method of using the cyanide is to melt it and heat it red-hot in a ladle or pot. The pieces to be case-hardened are heated and placed in the red-hot cyanide, and left there for some minutes. After "soaking" a proper length of time, they are hardened by cooling in cold water. This method, when properly carried out, gives a mottled appearance to the case-hardened surfaces if they have been previously polished.

The longer the articles are left in the heated cyanide, the deeper will be the penetration of the carbon, although not quite in proportion to the time. Heating in this way for about ten minutes will give a penetration of perhaps one-hundredth of an inch.

### Vibration of Pop-Valve

*Question:* I am operating a 25 horse-power traction engine, and have put the pop-valve above the cap. It is a 1½-inch valve, and the pipe leading from the dome to the pop-valve is 3½ feet long. The valve pops at 140 lbs.' steam pressure, and when it pops makes such a racket that it can be heard a mile away. How can this be prevented?—*K. Z. O.*

*Answer:* Probably putting the valve on the dome will obviate the trouble. This will be the only way to prevent vibration. If the pipe could be braced or tied firmly to the boiler, the noise could be lessened. The only cure, however, is to attach the valve directly to the boiler.



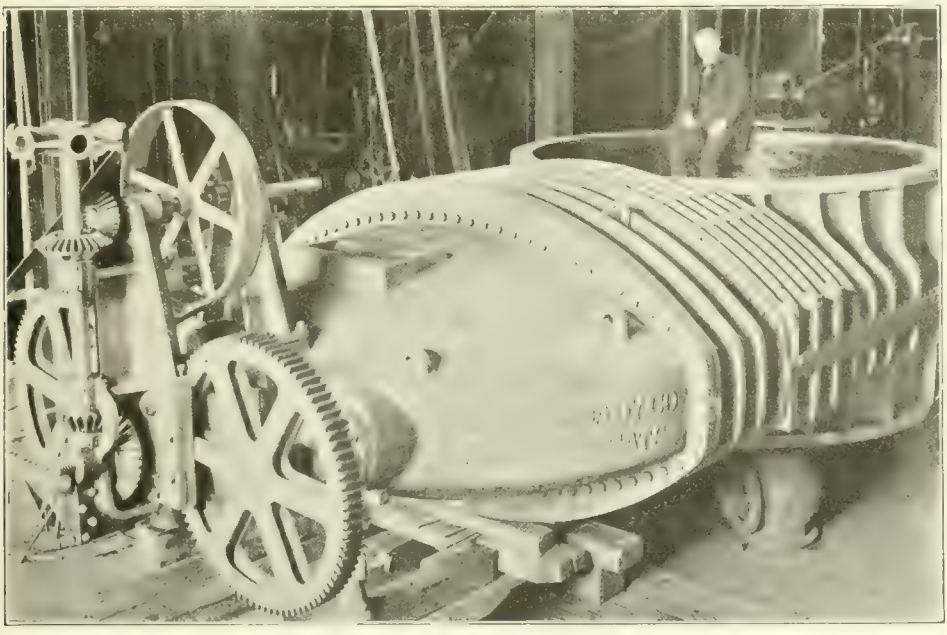
# ENGINEERING PROGRESS

## Largest Valve

PROBABLY the largest double-gate valve ever manufactured is that shown in the accompanying engraving. The picture, however, conveys no adequate idea of the size of the valve except when comparison is made with the size of objects of familiar knowledge. The diameter of the posts or pipe-ends of the valve is nine feet. The gross weight of the casting is 126,000 pounds, or more than sixty tons, and required three ordinary flat cars to transport it. The valve was made recently by The Pratt & Cady Company of Hartford, Conn., for the Niagara Construction Company of Niagra Falls, Ontario, for use in connection with their generating power plant; and this alone will serve as an intimation of the vast amount of water that will be used. The valve will be operated by electric motor controlled by manipulation from a distant station.

## Wreck on Logging Railway

THE accompanying photograph gives an indication of what a railroad wreck sometimes means in the Pacific Northwest. As is well known, the logging roads are built through a very rugged country; and frequently the route is over ravines varying from fifty to a hundred feet or more in height. As timber is so plentiful, most of the bridges are

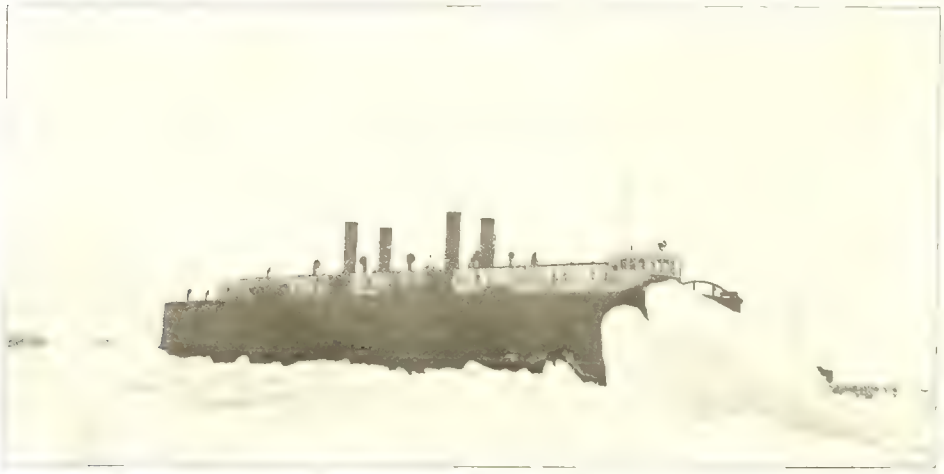


LARGEST DOUBLE GATE VALVE EVER MADE.
Diameter of ports, 9 feet, weight, 126,000 pounds. Built for the Niagara Construction Company by the Pratt & Cady Company, Hartford, Conn.

constructed of trestling unless the depression is too wide to be safely spanned by this form of construction. The illustration is of a wreck which occurred on Raging river, Washington. The railroad across this stream was supported by a structure upheld by wooden towers which were supposed to be safely anchored in the river bed. The action of the current, however, weakened one of the towers to such an extent that it collapsed as a train of logging cars was entering upon it, and the locomotive and nearly all of the cars fell to the bottom. The rolling stock was literally demolished as the photograph shows, logs being scattered in all directions. The boiler and forward part of the locomotive, however, were so little injured that the engine was removed, being raised to the top of the bank by block and tackle.

## Navigating Through Ice

ONE of the most novel and interesting experiences, to those who love the strenuous phase in travel, is the trip on one of the powerful railway ferries that ply between the old city of Mackinac and St. Ignace, in the Upper Peninsula of Michigan during the winter when the straits are covered with ice often four feet thick. It would seem incredible that any marine craft could be operated under such conditions, yet it is one of the commonplace things of today. The boats are supplied with wheels at the bow as well as astern; and the heavy ice is crushed down and forced under the big boat, thus opening a channel which allows her progress at a speed but little less than when the water is entirely open. The distance to be traversed between the two points is about nine miles; and even under ice conditions such as those shown in the acompanying illustration, the trip



Improvised Fire-Fighting Apparatus Constructed During a Serious Fire at Nome, Alaska.

has been made in but twenty minutes longer than the schedule time in summer. The view from the bridge, when midway of the Straits, is certainly a wild and inspiring one, and to the timid, perhaps, just a trifle disconcerting and suggestive.

## To Use Back-Winds

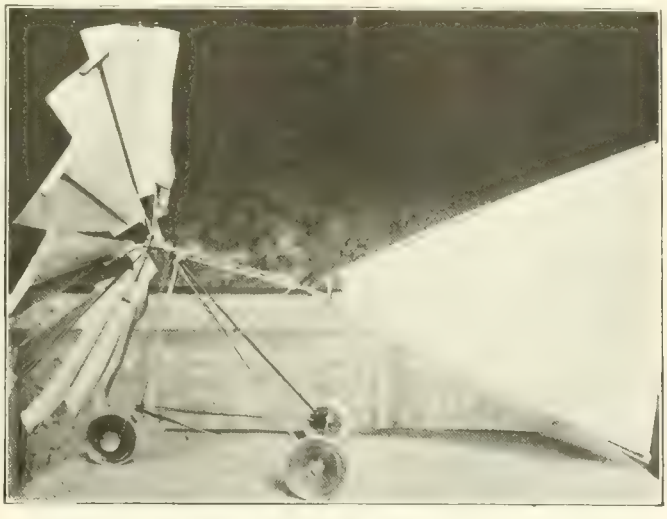
AN interesting outfit enabling back-winds to be utilized in the propulsion of motor-cars and cycles has recently been constructed by Dr. H. K. de. Haas. The device consists of a wind-motor acting through a chain transmission on a wheel of the cycle or automobile. In virtue of the directing effect of the broad wind-vane, the motor always adjusts itself against the wind.

From a theoretical consideration of the apparatus, the following results are indicated: The device will prove the more useful as the efficiency of the wind-motor is greater and the intensity of the wind is higher. The smaller the speed of traveling, the more efficient will the wind-motor be, and *vice versa*, there being a critical speed after exceeding which the motor exerts a delaying effect.

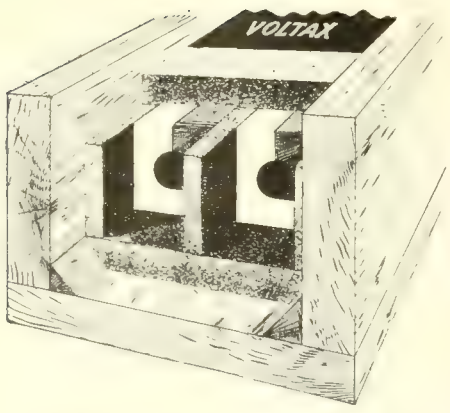
Quite apart from the possibility of a practical application of this device, it is extremely interesting, solving as it does a long-discussed scientific puzzle.

## Improvised Fire Apparatus

SOME months ago a serious fire broke out in Nome, Alaska, threatening complete destruction of the wooden buildings, of which the town is mainly built. The fire brigade, equipped with only one small engine and assisted by a bucket brigade which carried water from the ocean, was obliged to confine its efforts to saving the east end of the town. The west end was saved by aid of the improved apparatus shown in the accompanying cut, consisting of two boilers which were hurriedly dragged to the edge of a lagoon and there connected to a pump. This rough fire-fighting equipment had two streams playing within 45 minutes from the time of sounding the alarm.



Apparatus for Making Use of the Power of Back-Winds.



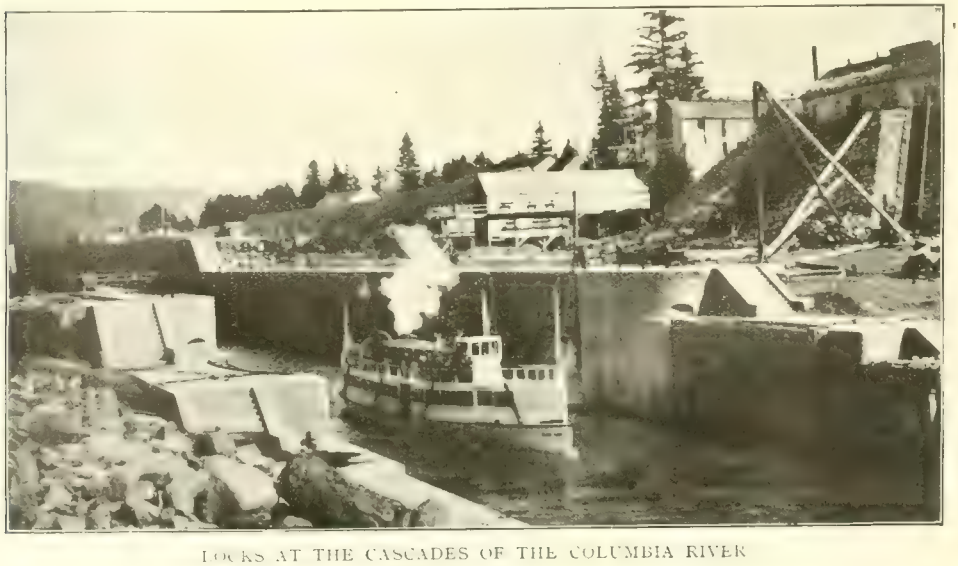

CONDUIT OF VOLTAX TRANSMISSION SYSTEM.
Showing layers of impregnated felt surrounding bridge-work and Voltax backing.

## Locks on Columbia River

ONE of the greatest rivers of the Pacific Northwest—the Columbia—is navigable for a thousand miles from its mouth by the construction of a series of locks at what are known as the Cascades. These locks are especially notable for the reason that they contain some of the most massive lock gates ever designed by engineers. The current of the Columbia at the Cascades is so powerful, especially during flood season, that it was necessary to plan barriers which would have far more resisting force than those utilized at the Sault canal or even the series of canals around the St. Lawrence rapids. The gates are constructed entirely of steel. The photograph shows the difference in the lock level, which is over twenty feet at this point.

## New Underground Transmission System

SEVERAL advantages are claimed for what is known as the "Voltax" system of underground electrical cable transmission, which has been developed in Germany. In this system, a wooden trough is first laid, in which are placed porcelain bridges for carrying the cables; but the essential feature consists—instead of using asphalt for filling the space between the wires—in employing a filling of suitable material impregnated with a secret compound known as "voltax," of extremely high powers of electrical resistance. It is said that by using this compound, all danger of breaking down insulation between the cables is obviated. The material will neither harden nor crack, and is so durable that it requires no expense for maintenance. It is waterproof and chemically neutral. New connections can be installed by simply opening the trench, and melting the compound with a plumber's blow torch.



LOCKS AT THE CASCADES OF THE COLUMBIA RIVER

In the matter of cost, the new system, it is claimed, has advantages over the old; and by avoiding the use of lead-covered cables, all possibility of attracting stray outside currents is prevented.

THE COMPLETED CROTON DAM.
Largest masonry dam in the world. Part of the water system of New York City. Fourteen years of steady work required for construction. Cost, $7,700,000.

## Croton Dam Completed

A NEW wonder was added to the world's great engineering feats on March 10 last, by the completion of the new Croton dam of the New York City waterworks system. The Cornell dam—as it is sometimes called, because of its site being a part of the old Cornell farm—is *facile princeps* among works of its kind. In its colossal masonry, in height, thickness, and volume of water confined, it has no rival. It is larger than the three great dams of Europe combined—the Vyrny dam in England, the Furens in France, and the Gileppe in Belgium; and while the Assouan dam, controlling the irrigating floods of the Nile, is longer than the Croton, it is only 70 feet in height as compared with the 301 feet of the latter.

The once narrow Croton river will now form a lake 2,400 feet wide at the dam, and reaching up the valley almost 20 miles, with an extreme width of two miles. The old Croton dam, about three miles upstream from the new structure, will be buried under 33 feet of water.

The new dam is 2,400 feet long, 216 feet thick at the base, and tapers toward its crest, where it is 10 feet across the top of the spillway and 21 feet wide at the top of the main dam. The water at the dam will be 160 feet deep.

# BLOWING OFF STEAM

### Yes or No

"My good woman," said the learned judge, "you must give an answer in the fewest possible words of which you are capable to the plain and simple question whether, when you were crossing the street with the baby on your arm, and the motor car was coming down on the right side and the dog cart was trying to pass the motor car, you saw the plaintiff between the carriage and the dog cart, or the motor car and the dog cart, or whether and when you saw him at all, and whether or not near the carriage, dog cart, and motor car, or either, or any two, and which of them respectively, or how it was."
—*Illustrated Bits*

### Baby's Head

*Wilhe pounded baby's head,*
*And the infant, wailing, said*
*"Ough, ough, upnty hum"*
*'Twas the head of baby's doom*
—Rochester Democrat and Chronicle

### Misleading

"Give me a package of chewing gum."

"We don't keep such things."

"Well, you've got a card in the window that says 'Typewriter Supplies.'" —*Houston Post.*

### The Impecunious Tenor

*There was a nice fellow named Jenner,*
*Who sang a phenomenal tenor;*
*He had little to spend,*
*So I often would lend*
*The tenor a ten or a tenner.*
—Saturday Evening Post.

### The Tables Turned

Husband—That beefsteak isn't cooked to suit me.

Wife—Well, cook it yourself; you didn't marry a cook.

Wife (in the middle of the night)—Get up, John, I think there are burglars in the house.

Husband — Get up yourself; you didn't marry a policeman.

### At The Head

*In life's great game, you'll notice that*
*The ones who take the winning trick*
*Have level heads but never flat,*
*Long heads but not the least bit thick.*

### Ancient Science

An Egyptologist and an Assyriologist were disputing about the relative advancement of the two ancient peoples whom they were studying.

"Why, sir," said the Egyptologist, "do you know that there have been found in Egypt remains of wires which prove that they understood electricity?"

"Humph!" observed the Assyriologist. "We *don't* find any wires in Assyria, and that shows they understood wireless telegraphy."—*Harper's Weekly.*

### Among The Saints

*A gallant young man in St. Peter*
*Said his girl was so sweet he could eat her;*
*"I or no peaches," said he,*
*"Are more luscious than she,*
*And I'm sure that molasses St. Sweeter."*
—Chicago Record-Herald

### Best Chance in the World

Butcher—I need a boy about your size, and will give you $1 a week.

Applicant—Will I have a chance to rise?

Butcher—Yes; I want you to be here at four o'clock in the morning.

### Got Busy

*There was a young fellow named Syd,*
*Who kissed a girl on the eyelyd.*
*Said she to the lad,*
*"Your aim's mighty bad,*
*You should practice a while." So he dyd.*
—Denver Post

### His Warm Friends

"Oh, yes," replied the wag. "I have many warm friends."

"Do they live here?"

"Oh, no, they are dead."—*Kansas City Drovers' Telegram.*

### Easter Gossip

*Dey's done had chicken at her house,*
*It's easy tellin' dat*
*By de contentment in her face*
*An' de feathers in her hat.*
—Washington Star

### The Commuter

"May I ask," inquired the melancholy stranger, "what is your pursuit in life?"

"It depends," replied Subbubs, "upon whether I'm going or coming. It's the 7:48 train in the morning and the 6:12 at night."—*Philadelphia Ledger.*

### Little Bo Peep—in Bostonese

*Diminutive Bo Peep has inadvertently become sequestrated from her merino pets,*
*And cannot at present clearly apprehend their whereabouts.*
*However, refrain from interfering with them, and they will of a certainty return of their own volition to their habitual abode.*
*Vibrating in their rear their posterior appendages.*

### The Matter with Moses

Johnny Paw, did Moses have the dyspepsia like what you have got?

Father—How on earth do I know? What makes you ask such a question?

"Why, our Sunday-school teacher says the Lord gave Moses two tablets."—*San Francisco News-Letter.*

### Their Last Agreement

*Harry loved Grace and Grace loved Harry.*
*And so at length they agreed to marry;*
*And that, as is often the case, indeed,*
*Was the very last thing upon which they agreed.*
—Philadelphia Public Leader

### Never Mind the Weather

The danger of sending telegrams is shown in the following story: A member of Parliament was to have made a speech at Derby, and, being unable to do so because the heavy rains had destroyed the branch railway, sent a telegram as follows: "Cannot come; wash out on line." In a few hours the reply came: "Never mind; borrow a shirt."—*New York Tribune.*

### A Correction

*'Twas not for want of bread he died,*
*But rather that he misapplied*
*The ample bread he had, I wot.*
*Before he went to bed that night*
*He witlessly blew out the light.*
*The gas escaped; the man did not.*
—New York World

### A Close View

Telescope Proprietor—Step up, ladies and gents, and view the planet Mars. One penny, mum."

Old Lady—Oh, lor'! Hain't it round and smooth!

Telescope Proprietor—Will the bald-headed gent please step away from the front of the instrument?—*Tit-Bits.*

### Domestic Felicity

Rodney—Do you have trouble with "shall" and "will?"

Dickey—Nope! my wife says "you shall," and I say "I will."—*Puck.*

# Engine No Bigger than a House-Fly

By T. H. Robinson

WHENEVER we speak of an engine, we associate the word with Power, and the many uses to which steam has been put by means of the engine lead to the belief that the steam engine is perhaps the most useful of man's many inventions.

By a horse-power we mean that power which is sufficient to raise 33,000 lbs. 1 foot in 1 minute at the earth's surface against the force of gravity. To a watchmaker, that seems quite a lift; yet in this age of giant engine construction it is no surprise to read of engines capable of exerting several thousands of horse-power. In this article, however, we go to the other extreme, and consider the construction of a steam engine so small that its power would seem to be better designated by the name of "flea-power" than "horse-power."

My first engine, shown in one of the accompanying cuts, was designed for a show-window attraction. It is an up-

Height, 1 inch; weight, 4¼ dwts.; bore, ⅛ inch; stroke,

right engine with oscillating cylinder made of brass, polished and lacquered, 1 inch high; stands easily on a Canadian five-cent piece (about 2-3 the diameter of an American dime); bore of cylinder ⅛ inch; stroke ¼ inch; and weighs 4¼ dwts., about the weight of a good wedding-ring.

When running, it makes a hum similar to that made by a bee. When I began this engine, I thought it would be small enough, but before I had finished it a strange thing happened. It appeared to grow, until when completed it seemed about twice the size I expected it would be. It proved a good window attraction, however, as it was probably the smallest ever shown in Toronto.

I decided to make a smaller one, something more worthy of a watchmaker's skill; and about this time I was looking over some back numbers of *The Keystone* (a jeweler's trade journal), and came across an account of two small engines made by two watchmakers, from which I noticed that miniature engine-making appeared to be a watchmaker's

disease, of which I was just beginning to feel the first symptoms.

Like other diseases, it must run its course. It's dangerous; but there is *one* chance of a neat recovery—that is, if you can make *the smallest* engine. Let those who are not afflicted with this disease be thankful, for the size is going down.

Entomologists tell us:

"Big bugs have little bugs upon their backs to bite 'em;
"And little ones have lesser ones; and so on *ad infinitum.*"

That may be true in Bugology, but there can be no *ad infinitum* in mechanics.

There must be some limit to the working size of an engine. It may be that we have reached that limit in the tiny engine illustrated. I do not show it as the smallest I can make, as I have tried this thing only twice, and you will notice a big drop in the relative sizes of the two engines herein described. I believe I can make a smaller one, if I have to.

"Tiny Tim," as I have named this smallest of all engines, is made of gold and steel, and is so small that a common house-fly seems large in comparison. It fits easily into the smallest 22 short cartridge, balance wheel and all. It weighs just 4 grains complete, that is about the weight of a common match. It takes 120 such engines to weigh 1 ounce, and 1,920 to weigh 1 pound—3,840,000 engines equal 1 ton.

The engine bed and stand are of gold. The shaft runs in hardened and ground steel bearings inserted in the gold bed. These bearings are counter-bored from the inside to form a self-oiling bearing. The fly-wheel has a steel center and arms, with a gold rim; and this part (the complete wheel) weighs 1 grain.

The cylinder is of steel with octagonal base highly polished. The stroke is 1-32 of an inch; bore, 3-100 of an inch, 17 pieces are used in the construction of this engine.

The feed is through the gold base, which is hollow. The speed of this engine is 6,000 revolutions per minute. When running 100 per second, no motion is visible to the eye, but it makes a note like the noise of a mosquito—caused by the vibrating piston rod.

The horse-power* is 1-498,000 of one H.P. Compressed air is used to run these engines, and it may be of interest to note that the amount required to make the *large* engine hum can easily be borne on the eyeball without winking.

Both engines were shown before an interested audience at the Canadian Institute, Toronto, lantern slides showing the construction, and magnifying glasses being used that all might see the little

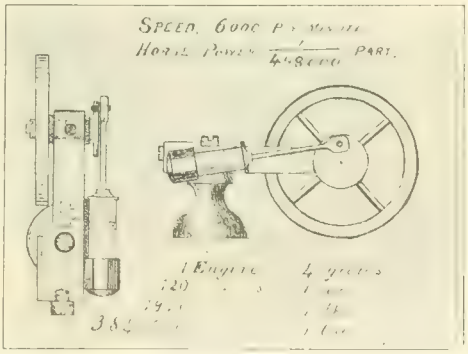



DIAGRAM AT LARGE SCALE SHOWING DETAILS OF MINIATURE ENGINE "TINY TIM"

engine running. Since then the shop has been visited by hundreds, and miniature engines promise to be an object of interest for some time to come.

Sometimes I am asked by the practical ones, "Why did you make them?" "What use can they be put to?" Well—it has been a pleasure to me to make them, and they have pleased many who have seen them who are always interested in small and accurate work. Their principal use, I fancy, is in the building line—reputation building—and so far they have done good work.

*NOTE. The speed and horse-power of the tiny engine have been carefully estimated by Dr. C. A. Chant, of the Department of Physics in Toronto University.

# WHERE HISTORY

Old Powder House at Marblehead, Massachusetts. Built in 1755. One of the old landmarks of the historic Bay State town.

Custom House, Salem, Massachusetts, where Nathaniel Hawthorne served as surveyor of the port, to which position he was appointed in 1846. Situated on Derby Street, nearly opposite Derby wharf. Hawthorne occupied the southwestern room on the lower floor. The stencil with which he marked inspected goods, "N. Hawthorne," is still shown. Many of his sketches depicted life here. General Miller, of Lundy's Lane fame, also served here.

# WAS MADE

The Old Gate at Harvard. One of the entrances to the famous "Yard." Rich in historic associations.

The Tucker House, in Marblehead, Massachusetts. Oldest house in the town. Built in 1640 and still occupied by the Tucker family. Samuel Tucker commanded the frigate "Boston," in which, in February, 1778, he conveyed John Adams as minister to France.

# SCIENCE AND INVENTION

## Pearls of the Pacific

ONE of the most curious industries on the coast of California is the clam fishery, as it is called. The clams, however, are very different from the ordinary bivalve of that name, and are known as *abalones*. While some of them are secured for food, most of them are dug up and exposed in racks on the beach until they die and decompose, when they are examined for pearls. Some of the pearls which are found adhering to the interior shell are of such a fine quality that they readily bring from $100 to $200 in San Francisco and other cities. Pearl hunting is the vocation of a large number of people who reside on the California coast in the vicinity of these clam beds. The jewels are so scarce, however, that a thousand clams may be opened without finding a single pearl; so the vocation is by no means very profitable.

## Illusion of Motion

PROBABLY everyone who has seen a "motion picture" of a vehicle traveling at a moderate rate of speed, has noticed that the wheels appear to be turning backward, and have speculated on the cause of this illusion. The explanation is quite simple.

The only proof of any motion of the wheel is the changing position of any one spoke, although the eye sees all the spokes at one time and notes the change of position of each and every one. When viewing a moving object, the eye does not record the movement by a series of mental photographs; therefore we see every motion of the object. The lense of the "motion picture" camera, however, impresses on the sensitive film the image of the object in one position, and an instant later the same object in another position, and so on, the completed record being a series of photographs of the object in different positions. When these are projected on a screen in rapid succession, the illusion of motion is obtained.

In the case in point, let us assume that the first photographic record shows the wheel of the vehicle in the position indicated in the diagram by the full lines. For the purpose of illustrating, we shall number the spokes as shown. Now, if the succeeding pho-

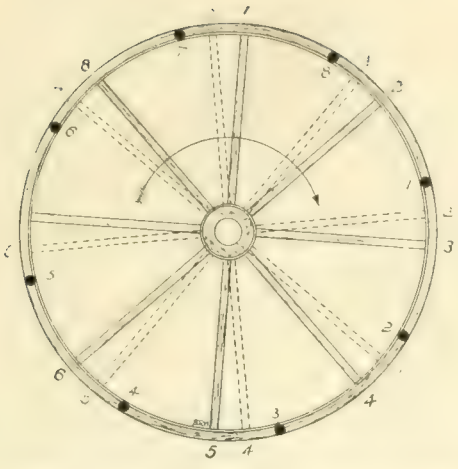


DIAGRAM EXPLAINING ILLUSION IN MOVING PICTURE OF REVOLVING WHEEL.

tographs were made with sufficient rapidity to reproduce correctly the forward motion of the wheel, the second record would show spoke No. 1 slightly in advance of the position it occupied in the first record; and if the subsequent exposures were made at the same speed, the wheel in the "motion picture" would revolve forward as it should. For many reasons, however, it is impossible to regulate the exposures in this manner, the speed of the wheel being much greater than the speed of the camera. Therefore, when the second exposure is made, spoke No. 1 has traveled considerably beyond the required position, and is photographed about in the position indicated by the dotted lines. The speed of the wheel and the time between exposures being relatively uniform, the space traveled by each spoke would be the same in each record photograph; therefore, at the time of the third exposure, spoke No. 1 has moved from the position occupied in the second photograph to the position indicated by the black dots. In the subsequent photographs, spoke No. 1 would always fall short the same distance.

The spokes in the "motion picture," however, are not numbered, and we cannot trace the movements of any particular one. If we watch the top of the wheel, we see in the first picture spoke No. 1 in a vertical position. The next picture shows a spoke in the position of dotted spoke No. 8. We mistake this spoke for No. 1, thinking it has moved backward. The third picture brings spoke No. 7 up to the position indicated by No. 7 black dot. This also is mistaken for No. 1, which now appears to have moved backward two spaces.

It sometimes happens that the time between exposures is such that in the second picture spoke No. 1 has moved up to the position occupied by spoke No. 2 in the first picture. In this case, the wheel appears to glide over the ground and not revolve at all.

## Dynamiting Stumps

IN Montana and other States of the Northwest, dynamite is used in the work of clearing land of stumps. The cut illustrates the method of operation. If the ground is hard, a hole is bored under the stump, and from one to five pounds of dynamite is placed therein, under the center of the stump, dirt being next tamped in around the fuse. In the case of a rotten stump or soft earth, the hole may be bored with an auger in the side of the stump near its root, and either powder or dynamite used. The explosion either blows the stump completely out of the ground or breaks it up so that it can be easily burned. The photograph was taken at a distance of 30 feet from the stump, on the side next the fuse—the safest side. Even at this

REMOVING STUMPS BY DYNAMITE.

## Dispelling Fog

THE inventor who will devise an efficient method of dispelling fog or counteracting its effect will reap a great fortune. It is said that one of the [illegible] in the latter part of December, costs the railway companies there $1,000,000, and the cabmen $5,000 a day, while the loss to merchants is beyond calculation. The [illegible] supply a town of 40,000 people an entire year.

It is estimated that in consequence of foul atmosphere, the people of the British capital are put to from $15,000,000 to $25,000,000 in unnecessary expense annually, and in winter enjoy sunshine only one-fourth of the time to which they are entitled. The effect of the fog is aggravated by the outpourings of smoke-laden chimneys, which infect the air, bringing periodically an alarming increase in the death rate through accident and from diseases of the respiratory organs.

## An Oil Picture

THE accompanying photograph may well be called a study in oil, for it represents a typical scene in the California oil district near Bakersfield. The surface of the oil forms literally a mirror, so that no matter which way the page is turned a perfect picture is presented. In this oil field, the flow of petroleum is so abundant that much of it is turned into earthen reservoirs similar to the one illustrated.

## To Prevent Seasickness

IN spite of the [illegible] methods which have been suggested in the course of the last few decades of avoiding seasickness, this is still the most serious inconvenience of a sea journey. In fact, neither the chemical remedies of modern medicine nor the mechanical devices suggested (for instance, a cardanic suspension of the berth), have met with any success worth speaking of. As regards, finally, the fitting of rotating tops into the body of the ship—a method devised by Herr Schlick of Hamburg—this might prove effective in diminishing the risks of seasickness, but no definite opinion can be formed until the present experiments have been concluded.

A novel process of a physical kind has, however, been tested recently, with most excellent results, on the steamship *Patricia* of the Hamburg-America Line and on the channel steamer *Peregrine*. This is based on a vibrating motion. The outfit is of great simplicity and merely comprises a comfortable chair, the seat of which is set rapidly vibrating up and down by the force of an electro-motor connected to the electric lighting mains of the steamer. Those wishing to protect themselves against the dreaded sickness should sit down on the vibrating chair, when they will feel about the same sensation as in riding in an automobile. The vibratory motion makes the rolling and pitching of the ship less felt, the slow downward motion of the vessel being counteracted by the numerous short vibratory shocks occurring in an upward direction.

The apparatus is the invention of Messrs. R. & W. Otto, of Berlin, Germany. On the *Patricia*, on a recent trip from Hamburg to New York and back, as soon as passengers felt the approach of sickness, they sat down on the vibratory chairs, when any uneasiness was removed, either immediately or after a short stay on the chair. Most of the patients remained free from the illness throughout the journey, even after leaving the chair; while in some other cases the sickness returned a few hours after leaving the chair, to disappear and finally to be removed entirely after another treatment. In a third series of cases, mainly comprising extremely susceptible persons, the characteristic symptoms of seasickness, after having been kept away during the stay on the vibrating chair, would immediately return on leaving the latter. These passengers, accordingly, remained for hours (in some cases up to ten hours) in the chair, but even in the case of so plolonged a treatment no noxious effect was observed. Everybody rather agreed on the pleasant effects of a stay in the chair, and many even took their meals there. Not a single case of the "return of the swallows" was recorded.

The writer is indebted for the above particulars to one of the inventors, who, after invariably suffering from seasickness in his numerous trips across the Channel, did not experience the least uneasiness on a recent journey, even in stormy weather, when testing his vibrating chair. The latter thus seems at last to afford the long-sought remedy against this dreaded illness. The much-discussed idea of "floating sanatoria" will now be susceptible of realization.

VIBRATING CHAIR FOR PREVENTING SEASICKNESS.

While being mainly a means of preventing the illness, the new apparatus has been found efficient also in some cases of advanced seasickness. The apparatus has been patented in all countries.—DR. A. GRADENWITZ.

## Salmon Wheel

ONE of the picturesque methods of fishing on the Columbia river is by means of what is called the "salmon wheel." This is sometimes fastened to the forward part of the barge, which is anchored in the river; but most of the wheels are set in a framework secured to the river bank at a point where the shore juts out into the stream. The wheel can be raised and lowered in a timber framework by means of a block and

tackle, so that it can be adjusted to the height of the water. It is merely a circular net designed somewhat similarly to the paddle-wheel of a steamboat, the "paddles," however, being covered with heavy wire netting with openings into which the fish pass. The wheel is revolved entirely by the action of the current, which at high water is very strong. Advantage is taken of the movement of the salmon upstream at different times of the year, as each fish as they hug the shore to avoid the force of the water in the center. Consequently they frequently fall into the net as it revolves, and are thrown into troughs in the center of each compartment, thence sliding upon the platform, where they are secured by the fishermen. When the salmon are "running" upstream, sometimes over a ton of fish will be taken in twenty-four hours by the salmon wheel, as operations are carried on by night as well as by day with the use of artificial light. The accompanying photograph is of one of the larger salmon wheels which have been built near the Dalles.

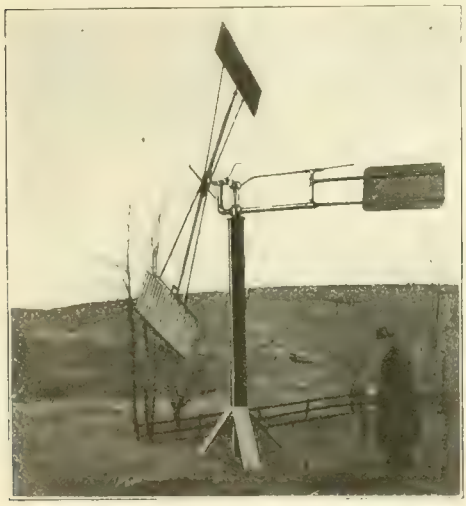
## Old Block Fort

AN interesting memento of the early days in the Pacific Northwest is shown in the accompanying cut which pictures one of the old block forts located on the shore of the lower Columbia river in Oregon. Legend has it that the blockhouse was really constructed by the band of Lewis and Clark when they made their memorable journey across the continent to the Pacific. It is located but a few miles from the ocean, and, as the photograph shows, is pierced with apertures for rifle fire. For a number of years it was used by the early settlers in the Oregon country, to defend themselves from the attacks of the Indians.

## Oscillating Windmill

A TYPE of windmill which eliminates many of the objections to the ordinary type with its complicated gears and bearings, has been invented by Mr. Charles McGregor of Nashua, New Hampshire.

In the ordinary type, the greatest item of expense is the cost of attendance. A mill of the new type, however, it is claimed, can be erected anywhere, and depended upon to take care of itself with very little or absolutely no attention.



An Oscillating Windmill.

This result is accomplished by not only getting rid of the gears, but by substituting rolling for bearing friction on the pump rod as well as on the main shaft.

The essential feature of the new type of mill is the manner in which its sail area is mounted. Instead of putting the available amount of sail area into a comparatively small circle at the end of a rapidly revolving shaft which has to be geared down to adapt its power to ordinary purposes, Mr. McGregor places an equivalent area at the ends of a reciprocating beam. This beam is considerably longer than the diameter of the usual wheel of equal capacity, so that the wind pressure produces a proportionately greater turning effort at a speed consistent with safety. The dangerous effects of excessive wind are avoided by an automatic device regulating the angle of the vanes, causing them to run at safe speed or to come entirely to rest.

The accompanying illustration is of a half-sized model which has been in successful operation. Full-sized mills have been running with entire satisfaction to their owners, for more than a year, at Amesbury and at Beverly, Mass.

## A Solar Incubator

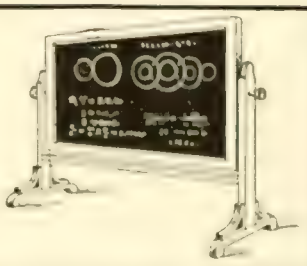
IN Ohio, if the poultry raisers cannot afford the double-acting, steam-heated chicken hatchers, they make use of anything which is handy in place of the ordinary setting hen. It has remained for Henry Decker, an old farmer living near Rome in the Buckeye State, to use beehives for this purpose. Mr. Decker happened to have two or three empty hives; and as his hens "went on strike" and refused to set on their nests, he decided to raise his chickens without their help. So he took a piece of cotton cloth, laid the eggs in it, then covered them over with a thick chair cushion, placed the eggs in the hive, and awaited results. In

Setting the "Sun Incubator" at Work.

a short time 18 out of the 20 eggs were turned into chirping chicks. Since then, Mr. Decker swears by the beehive, and all he asks of the hens is to do the laying, and he will do the rest.

# CHALK TALKS

by CARL S. DOW.



## Number XXIX—The Negative

IN Chalk Talk No. XXVIII. some fundamental principles concerning the camera, the lens, focus, and exposure were briefly explained. The setting-up of the camera is purely mechanical, although the selection of the view or the grouping of the objects or people often calls for considerable artistic ability. The act of making the exposure also is mechanical, but the effect it produces is chemical. Exposing the plate admits light which makes a representation of the image on the dry plate; but a complete understanding of the theory of the effect of the light and the subsequent operations of making the negative, requires a knowledge of chemistry, for these are chemical actions and more or less complex.

### The Dry Plate

The glass dry plate is a piece of clear glass coated with a film which consists of finely divided particles of bromide of silver held in an emulsion which is kept in condition for use by the gelatine film. The "films" for kodaks and other small cameras are simply the film part of the plate with a substantial gelatine backing.

Now, bromide of silver is extremely sensitive to light, far more so than the human eye. If this compound is exposed to sunlight for a very small fraction of a second, it changes in chemical properties, although in appearance it remains the same as before. This has caused many beginners to expose plates a second time, thus making two pictures on one plate, or led them to try to make a negative from a plate never acted on by light. A photographer must have some system whereby he knows what plates have been exposed.

### Developing

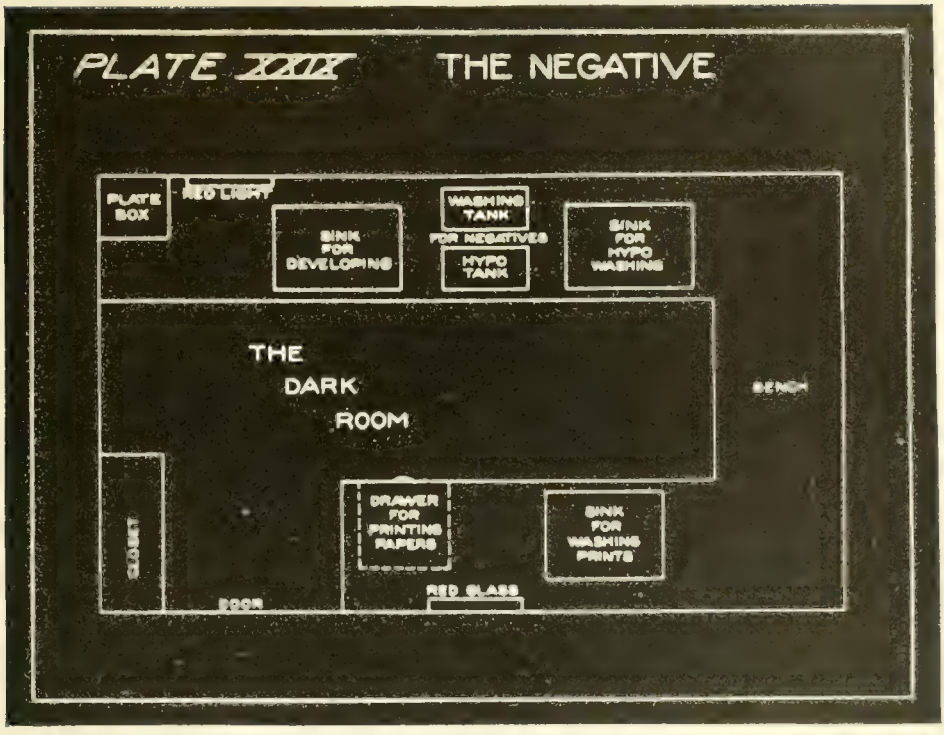
After "pressing the button" or otherwise admitting the necessary light to the dry plate, the negative must be made; or, in other words, the image, hidden in the film but nevertheless imprinted there by the light, must be brought out, or *developed*, as it is termed. This is accomplished by a chemical process called *developing*, and the solution or liquid used is the *developer*.

The dry plate or film must be developed in darkness, or by a dim light of such color that it will not injure the plate. The usual form of dry plate is least sensitive to red light, hence this is used by the photographer for his dark room, and if dim is usually perfectly safe. During exposure, some portions of the film were in the paths of the rays from light objects, and these rays changed the chemical properties of the bromide of silver. When immersed in the developer—the composition of which is given on the circulars accompanying dry plates—the solution transforms the "changed" portions of the bromide of silver into metallic silver, which, nearly black and opaque, forms the dense portions of the negative because it represent the light colors which acted chemically on the bromide of silver.

The film is now made up of two parts—the metallic silver, which is insoluble in the soda solution; and the unchanged bromide of silver, which is readily soluble. Of course there are *half-tones* or areas representing different grades of light, partly metallic silver and partly bromide of silver.

### Fixing

The unchanged bromide of silver must be dissolved from the film else it will change in properties on exposure to light, thus defeating the purpose for which the negative is made. After development, the plate is placed in a solution of *Hyposulphite of soda*, which dissolves the bromide of silver. This soda solution must




be thoroughly washed from the film; and, after drying, we have a permanent negative by means of which thousands of prints may be made. *The washing must be thorough;* if any trace of the hypo-sulphite of soda remains in the film, it will in time destroy it, turning it yellow, causing the image to fade, and even loosening it from the glass. Many photographers use one tray, washing tank, or sink for washing out hypo; that is, these trays are used for washing hypo from plates or prints exclusively, never for developing or for any other part of the process.

### The Dark Room

Any room from which all light can be excluded may be used for developing plates; for evening work, one's kitchen answers very well. If a room is at the beginner's disposal, he can with little effort arrange the benches and sinks very conveniently.

On the blackboard is shown a plan of a dark room. Two red lights are provided, one for developing and the other for placing plates in the holders. With this arrangement, there is little chance of the bench for the latter work becoming wet. In this dark room, one sink is for developing, and one for hypo washing, with a hypo tank for fixing and a washing tank for negatives between.

### The Negative

The above describes very briefly the process of making the negative, but it may not be out of place to add a few hints on the negative itself.

After a little experimenting, or what is often more economical, getting the advice of an experienced photographer, adopt a developer and stick to it. Also select a brand of dry plate, or at most two kinds, depending upon the work in hand. Cheap plates are not the most economical in the end. Be sure your light is safe, and take your negative to it as little as possible; you will be surprised to see how little you use the light for examining the progress of development. Use plenty of developer, but filter it frequently. Always leave the negative in the fixing bath about twice as long as is necessary to remove the yellow emulsion. Wash the negative in cold water, and wash it thoroughly. Aim so to select your materials and judge the exposure that your negatives may retain all the fine half-tones; it is better to over-expose, for you can reduce the density with *potassium ferricyanide.* Do not use much *bromide of potassium,* for it makes contrasty negatives and consequently harsh prints. Above everything, *keep all your appliances clean*

# New Hanging Gardens of Helena

By

JOHN A. RAFTERY

THE strangest and most interesting park project ever undertaken in this country is to be found at Helena, Montana, where the citizens are engaged in transforming the bald slopes of a conical mountain which towers nearly 1,400 feet above the city, into a forest park.

There is no spring, well, brook, or pond upon the bare sides or rocky summits of this singular park; nor will it be possible to raise water from the valley for the irrigation of trees, shrubs, and flowers; yet the expert foresters of the Federal Bureau who spent last summer planning for the planting of the park, are agreed that several varieties of evergreen trees will flourish there without water or attendance.

Forty years ago, while Last Chance gulch, which skirts the eastern base of Mount Helena was the richest placer mine in the world, the mountain, from the margin of the gold-strewn creek to the shining peak of stone, was covered with a dense forest of fir, spruce, and pine. The Argonauts of the early 60's commenced the work of denudation when they built the first log cabin. Saw and planing mills ate away the lordly trees [illegible] for mine timbers, for bridges, for corduroy roads, and, later, for railroad ties, tier after tier of these century-old trees were cut and hauled away.

Then came horses, cattle, and sheep to graze upon the short grass and scanty herbage of the denuded slopes, until, at last, when such creatures must have starved upon the sparse pasturage, goats were turned loose to browse upon the shrubs and young trees, and so to complete the destruction of what had been, and should be now, a noble mountain forest. There are yet a few hundred full-grown forest trees upon the upper reaches of the mountain and on the northern and western slopes furthest from the encroaching city; and these thickets are slowly spreading their seeds which, year after year, add a few recruits to the decimated ranks of their elders.

Guarded from fires and the invasions of man and beast, the waterless acclivities of this mountain would in time reforest themselves. But it would take centuries to replace in this way the wanton destruction that has been wrought in twenty years. The people of Helena have only come to the aid of nature in the work of retimbering the splendid eminence which [illegible] their city, and

with their best efforts they can but shorten the process by a few decades. People of lower altitudes and more southerly latitudes would not believe without seeing how little the trees indigenous to this region require in the way of moisture, fertilization, and care.

A wind-blown seed, an inch of shade, a little snow, and peace—that is all there is need for, to make a beautiful tree upon the mountain sides of Montana. The writer has seen stunted but sturdy pines twenty feet high growing out of the narrow crevices of rocks high up the mountains, where rain seldom falls and where moisture cannot linger long. Indeed, there are in Colorado Gulch, a few miles from here, two gigantic boulders ten feet or more in diameter, which have been split open by the roots of trees that sprouted in small orifices in their upper surfaces. The seed that fell into that inhospitable "soil" had nothing to protect or nourish it; but such was its tenacity of life that it bored slowly downward like a diamond drill until it had split the granite prison which confined but could not kill it.

To make a forest wave where now is nothing but the ashen face of a wind-swept mountain, is, then, not so disheartening. The people of Helena commenced by acquiring, in the name of the city, all of the government land then unoccupied upon the mountain. Owners of other parcels on Mount Helena willingly deeded hundreds of acres which they had taken up as mining properties. The transfers so recorded convey the surface of the land to the city for park purposes, but reserve the mineral rights beneath to the donors. About 1,200 acres have thus passed into the possession of the city of Helena.

The Bureau of Forestry at Washington was next interested in the project. Chief Forester Gifford Pinchot and his assistant, E. A. Sterling, were no sooner apprised of the unique plan of the Montanians than they agreed to aid it to the limit of the power of the Bureau. The extraordinary advantages of the site, the opportunity of projecting a striking and accessible object-lesson in the forestation of arid regions, and the remarkable progress which the people of Helena had made in the work, doubtless urged the federal foresters to unusual efforts and enthusiasm in behalf of the scheme.

Three expert foresters came from Washington last summer to chart the mountain and to prepare a plan of planting. The people of Helena bore the expense of this work, and furnished accurate surveys, maps, and elevations of the proposed park. The foresters estimated the acreage to be planted, and specified the number of seeds, the process of caring for the nursery stock, the system of planting out, and the varieties of trees that will thrive upon the ground.

The trees must be two years from the seed before they are fit to be set out, but the people of Helena were not discouraged by such unavoidable delays. Last autumn a number of volunteer seedsmen, assisted by school-boys, pillaged the mountain forests hereabouts for seed-bearing cones. These were carried to the nursery, and the seeds will be set out this spring, to be transplanted to the mountain park in due time. Meanwhile the city has assumed charge of the mountain. Cattle, sheep, horses, and goats are prohibited from grazing or wandering over it, and contracts have been let for the fencing of the whole tract.

The project having advanced so rapidly and so successfully, the forestry authorities at Washington have decided to go a step further in realizing what is, in many respects, the most extraordinary and yet feasible undertaking ever addressed by the foresters of any country. The Bureau of Forestry is not permitted to supply trees for landscape gardening, for private purposes, or for any objects except experiment or the reforesting of national reserves.

The Mount Helena Forest Park enterprise is, however, to be made the subject of extensive experiments by the Bureau. The Chief Forester has approved of the transplanting of fifty thousand trees from the Halsey nursery on the Dismal River Reserve in Nebraska, to Mount Helena, Montana; and the work of planting them has been in progress under the supervision of Forester F. G. Miller of the Bureau. The federal authorities insist that the planting of these trees is not to be regarded as a gift to Helena or an adventure into landscape gardening, but a federal experiment justified by the un-

usually favorable circumstances attending the strange project of recreating a true forest upon a waterless and now barren mountain.

The unexpected success that has attended the Mount Helena plan has aroused the interested co-operation of many Montanians. The State Nurseries have volunteered to plant out 300,000 bulbs of such flowering plants as the tulip and narcissus, which will grow wild and in ever-increasing profusion wherever they are set upon these mountains. The bulb thrust into a hole in even the most exposed ground, thrives without further care, the only change noticeable in the habits of the plant being a gradual diminution in the size of the gaudy blooms.

A spiral foot-path has been graded from the city to the summit of Mount Helena, and there an ornate pavilion has been erected upon the highest point of rock, 1,400 feet above the main street. In the cliffs of the peak there are two spacious natural caves, which will be tenanted by specimens of the native bears, lions, and other carnivora of these mountains. Parks enclosing herds of deer, antelope, moose, elk, and buffalo will be added as the present limits of the tract are extended upon the desert lands which lie back of the mountain.

The work of planting young trees, as managed by the Bureau of Forestry, is a very simple and rapid process. Two average planters will set out five thousand trees in a working day, for there is nothing to it except the making of a hole for the roots and thrusting the young tree into it. Only the cone-bearing evergreens will be used. Yellow pine, spruce, red fir, and one or two other conifers, drouth-resisting, hardy, and indigenous to high altitudes, will cover the vacant slopes of Mount Helena by next summer. It will be years before these plantations will have attained the height and dignity of goodly Christmas trees, but from the day of their planting they will make the mountain green, conserve its snows, renew its sod, and transfigure its desolated

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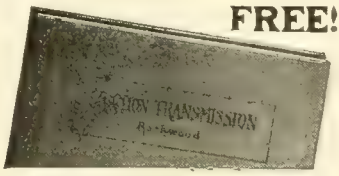

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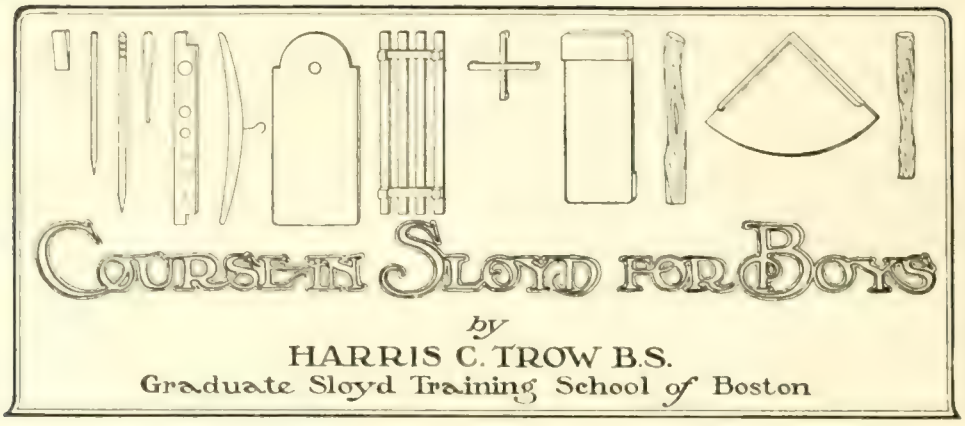
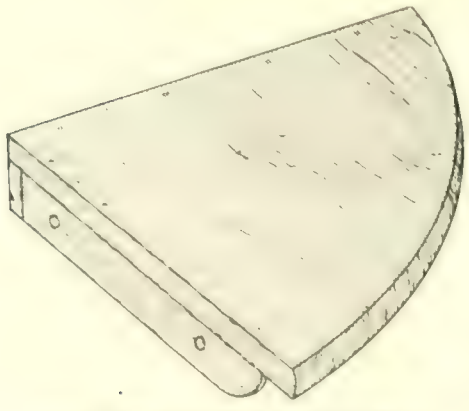



## Seventh Lesson—Model No. VII—Corner Shelf

A GENERAL view of this model is given in Fig. 1 in perspective; and a working drawing with dimensions is shown in Fig. 2, the view at the left being the plan, and the one at the right being the side elevation. All the tools required in construction of this model have been brought into use in the previous lessons, so that no new ones need be introduced. The stock used should be good, clear white pine of ⅝-inch thickness.

As shown in the sketches, the surface of the shelf consists of a piece in the shape of a quarter-circle of 10-inch radius and ½-inch thickness, secured to two supporting strips, one 9⅜ inches and one 8⅞ inches long, 1 inch wide and ½-inch thick.

These strips should be gotten out first. Begin by roughing out a piece of stock with the rip saw and crosscut saw, long enough for the two in one piece, or about 18½ inches in length and approximately 1⅛ inches wide. Finish one of the wider surfaces straight and smooth with the jack-plane. Next plane one of the narrow surfaces at right angles to this. Gauge the width of one inch; and plane a second narrow surface at right angles to the surface first finished, to the gauge mark. Having done this, gauge the thickness of ½ inch on both the narrow surfaces, and plane to these gauge marks. Next block-plane one end of the piece square and smooth, using the block-plane in the bench-hook; and lay off the length of 9⅜ inches, cutting as near to this line as possible with the back saw and finishing with the block-plane in the bench-hook.



In laying off the piece to length to be cut off with the back saw, it is well to mark the length first with a pencil, and then to run over this line with the point of the Sloyd knife. Square the ends of the second piece to length 8⅞ inches in a similar manner. One end of each of these pieces should now be rounded to a curve of one-inch radius by means of the Sloyd knife, using it, of course, *with* the grain and *not against* it. These pieces should then be chamfered, as shown by the dotted lines in the plan and elevation views in Fig. 2, using the spokeshave and the Sloyd knife in this operation. Some study may be necessary in laying out this chamfer; but all necessary dimensions are clearly shown in the

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sketches, and no serious difficulties should be experienced.

The holes should now be bored with a 3-16-inch auger bit in the locations given in Fig. 2, and the sandpaper and block used to add the finishing touches.

The body of the shelf, as already mentioned, consists of a piece in the shape of a quarter-circle of 10-inch radius. A piece of stock, accordingly, should be roughed out of the ⅝-inch pine about 10¼ by 10¼ inches. Finish one of the broad surfaces by means of the jack-plane perfectly straight and true, in direction of both its length and its width, making each cut of the plane-iron join smoothly with its neighbors. With a surface as broad as this, it is also necessary to guard against wind, and the test with the winding sticks already described should be applied. Next finish one narrow surface at right angles to this. Having done so, plane one end straight and smooth across the grain at right angles to the finished narrow surface and the finished broad surface. This should be done without the aid of the bench-hook; and the jack-plane, not the block-plane, should be used. The plane must be very sharp and set to take off only a very fine shaving. The cut should be made not clear across the end, but from both edges toward the middle.

Having finished the end satisfactorily, lay off the arc of 10-inch radius by means of the dividers; cut the stock down as closely as possible to this line with the turning saw, making the cut with the grain and keeping it square with the finished broad surface. The spoke-shave is to be used to finish exactly to the line, care being taken here, also, to cut with the grain and not against it. In this operation of smoothing with the spoke-shave, the cut should be kept perfectly square with the broad surface.

Next gauge the thickness of ½ inch on both the straight, narrow surfaces and the curved one, and finish to these lines with the plane. The curved surface, as shown in Fig. 2, is not left perfectly square, but is rounded slightly, back to a distance of 1-16 inch. Accordingly, an arc should be lightly drawn on both the broad surfaces, from the point previously used as a center, with a radius of 9 15-16 inches. The edge should then be rounded to these lines as evenly as possible, by means of the spoke-shave. Finally, a piece of sandpaper, held lightly in the fingers of both hands and on either side of the work in such a way

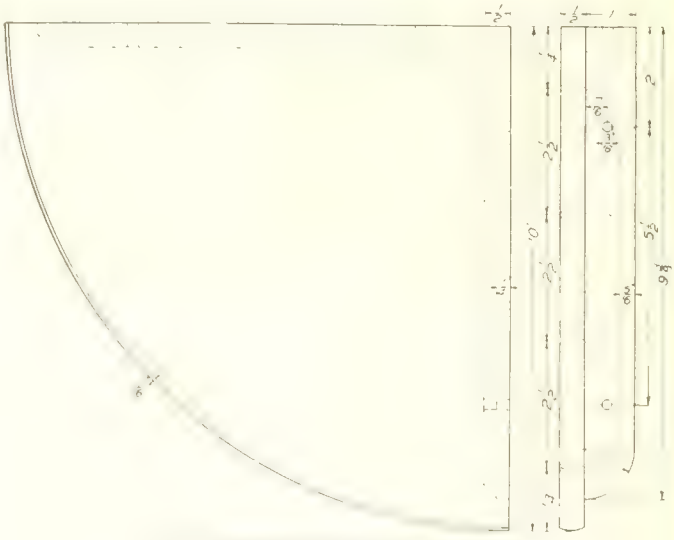
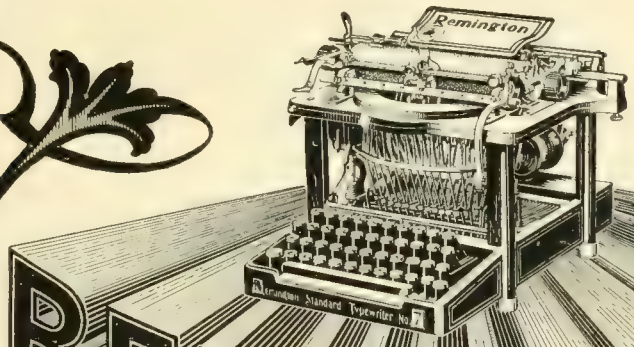


FIG. 2. WORKING DRAWING WITH DIMENSIONS.

that it exactly conforms to the round given by the spoke-shave, should be used to smooth out any irregularities left by it. Having finished this edge, all the other surfaces should be smoothed with the sandpaper and block.

The parts are now ready to be assembled. The supports should be placed in position, as shown, and secured by means of one-inch brads located as indicated in Fig. 2, four to each strip. The heads must be set in flush with the surface by means of the hammer, and should then be sunk a little below it with the nail-set. After the supports are secured in position, it may be necessary to take a light shaving off here or there with the plane in order to make all the joints perfectly flush. The whole model may now be touched up lightly with the sandpaper and block.

# The New Models of the

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# Divining Rods

By Dr. A. Gradenwitz

Berlin Correspondent of Technical World Magazine

IT is a strange fact that many doctrines, universally accepted once upon a time, but rejected later on as unscientific, should now again be taken up. A striking example is afforded by the ancient doctrine of *alchemy*, which, after having given rise to the development of chemical investigation, was subsequently discarded as incompatible with the results of that same science. Now, in the light of modern chemistry, a possible conversion of one element into another, so far from seeming paradoxical, has apparently been observed in the case of helium and radium, so that there is no reason left for denying the possibility of achieving the same result in connection with other elements.

Another interesting instance, though of much less importance, is the case of "divining rods." These, it will be remembered, were in the Middle Ages believed to be useful in finding out the situation of underground springs and veins of precious metals. Their use can be traced back to the remotest antiquity. In fact, a reference to a goddess called the "Mistress of the Magical Rod" has been found in the library of Nineveh, and the serpentine rod of Hermes seems to be nothing else than such a rod. It was, however, in the Middle Ages that the use of divining rods was developed to a special art practiced mainly by miners. A fork-shaped hazel bough solemnly cut in the midsummer night was

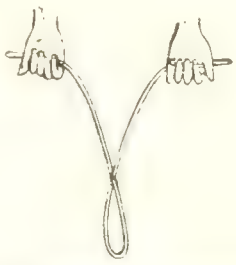

FIG. 1.—OLD FASHIONED TYPE OF DIVINING ROD.

considered as being especially efficient, and was mostly carried in front of the breast with hand clamped round the ends of the fork and its stem pointing upwards. The belief was that whenever the carrier of the rod came in the neighborhood of the hidden objects, the stem of the fork would be thrown toward the place in question. Experiments were made at the beginning of the nineteenth century by Amoretti and the physicists of the Munich Academy on what was called a "bipolar cylinder," being a metal rod kept between the thumb and index, and the "siderical pendulum," which was a piece of coal, pyrite, or the like, suspended from a wire, and which, under the influence of hidden metals, would be set vibrating. The science of last century, however, disdainfully rejected the divining rod as a nonsensical superstition, it being thought that the rod would move only when the carrier himself believed he had found the secret object.

Some recent instances, however, are on record to prove beyond doubt the real existence of such things as divining rods, which proof is mainly due to the experiments made by Baron K. von Bulow Bothkamp and Herr J. Passehl, of Gustrow, Germany. An interesting fact is that the rods used by these experimenters will respond only to underground springs, whereas an open sheet of water

USING A DIVINING ROD.

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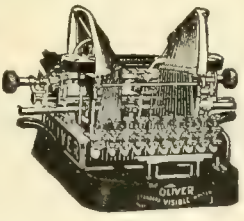

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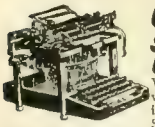

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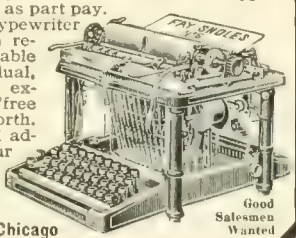


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is without any influence on them. Another remarkable feature is that a special personal aptitude or nervous susceptibility seems to be required for handling these mysterious rods, and this would account for the negative results obtained by previous experimenters.

The accompanying photograph shows

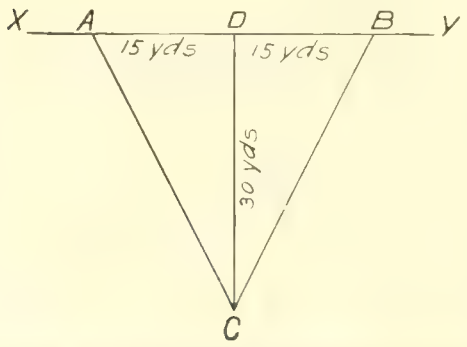


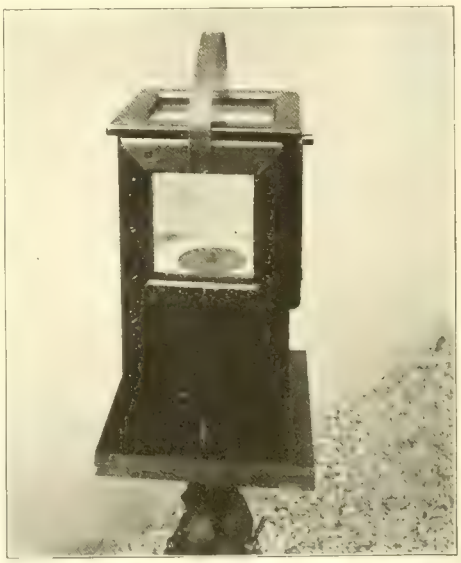

Fig. 2. Diagram Illustrating Method of Locating Underground Springs.

Mr. Passehl while searching for artesian water with the aid of fork-shaped willow-rods, the fork pointing upwards. Whenever the ground traversed contains a spring, the fork will drop somewhat; and as soon as the operator has come to the place under which the spring is situated, it will suddenly point downwards.

After finding out the position of the spring, its depth below the ground can be calculated. In order to understand this, it should be mentioned that the effect exerted on the rod is ascribed to some kind of unknown radiation given off by the spring. Whether this radiation is connected in any way with such kinds of rays as have been discovered by modern science, we are as yet unable to ascertain. Anyhow it has been found that each spring, in addition to the vertical radiation, gives off two well-defined oblique rays. After first ascertaining the direction and center of the flow (corresponding to the maximum response of the fork)—namely the point *D* (Fig. 2)—the depth *D C* is found by walking from *X* or *Y* at right angles to the direction of the flow when at *A* or *B* a response is observed, which however ceases as soon as the position of the operator is altered even by one step to the left or right. After measuring by means of a tape the distance *A D*, the point *B* will be obtained symmetrically with regard to *A*, and the divining rod will show there exactly the same behavior as at the point *A*. The distance from *A* to *B* will be equal to the depth of the spring.

A scientific explanation of this curious phenomenon will no doubt be found some day by scientific investigation; in the meantime the practical utility of "divining rods" should not be underrated, the more so as they seem even to respond to underground veins of gold and other metals.

A Swiss engineer, Mr. Adolf Schmid, has quite recently invented a less primitive instrument than the divining rod, intended for the same purpose, and comprising a convenient combination of a magnetic needle and a coil arranged in the magnetic meridian. Whenever this instrument (patents for which have been obtained in several countries) is placed above a spring, the needle will begin performing more or less rapid but rather lively oscillations.



Schmid Electrical Divining Apparatus.

In contrast with the divining rod, which does not seem to work except in the hands of those endowed with a special susceptibility, this instrument can be used with the same success by everybody.

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J. F. Bruce, Inventor of Detergent, in front of Fountain.

# Cleaning the U. S. Treasury

## Uncle Sam's Great Treasure-House is Treated for Its Complexion

By HY. E. CHANDLEE

THE Treasury Department has been cleaned—not of figurative filth in the form of graft, by the hand of the Keep Commission, but of actual dirt by a force of workmen who for several weeks were busily engaged in removing the stains of time and weather which for many years defaced the massive walls and lofty columns of the huge building wherein are kept the surplus millions of Uncle Sam's treasury. For many years the Treasury Building stood, a somber pile, at the head of lower Pennsylvania Avenue, the cheerless drab of its dull exterior mottled and streaked by the storms and sunshine of many years. During the last fall, however, a force of men were put to work on the building with a powerful detergent, with which the entire surface was treated; and as a result it now stands forth in its original whiteness. So efficient was the treatment, that many received the shocking impression that the building was being whitewashed.

The detergent referred to is a liquid compound discovered by J. F. Bruce, of Washington, D. C., and is the result of several years of careful experimenting. Having been a stone-mason since boyhood, Bruce was long ago impressed with the great demand for some efficient stone cleaner which could be produced at low cost, and which could be applied in such a way as to make the cleaning of a building possible at a comparatively low figure. Accordingly he began, a few years ago, a series of experiments in the production of detergents, and met with gratifying success in the discovery of the present compound about two years ago. At that time he visited the Treasury De-

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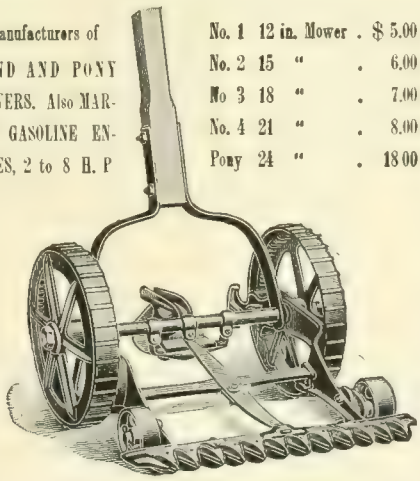

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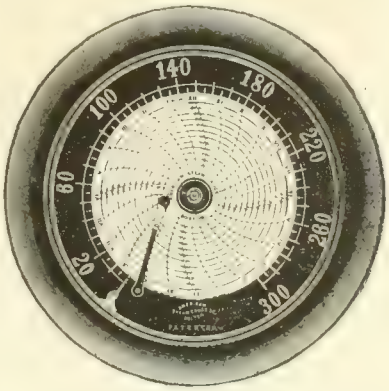


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partment, seeking permission to try his composition on the greatly discolored stones of that building; and, after considerable difficulty, was allowed to clean a single stone in one of the areas at the West front of the building. This block of granite was so discolored as to be almost black, but upon the application of the cleaner, quickly regained its original color. The effect of the compound was so startling, that those in charge of the building feared injury to the stones through the action of the liquid, and Bruce was restrained from further experiments on the stonework.

Shortly after this occurrence, the Treasury was subjected to a sand-blast treatment, in an effort to clean it, but with little effect. Meanwhile Bruce secured a contract to clean the granite base of the railing surrounding the New Willard Hotel at Washington, and afterward presented to the Treasury Department another application for a contract to clean the building, calling attention to his work on the hotel as evidence of his claim that the detergent contained no ingredients injurious to the stone. After carefully considering the matter, the Treasury Department rewarded him with a contract to renovate the entire building, and work was immediately commenced.

Many of the large columns had become so discolored as to resemble bronze more nearly than granite, and the greater part of the building presented a dull appearance, in startling contrast to its near and spotless neighbor, the White House. As soon as Bruce's workmen began on the structure, these stains began to disappear rapidly. Column after column stood again in snowy whiteness; and the entire building seemed to be putting on, by degrees, a robe of white. The work has been but lately completed, and the Treasury appears as an entirely new structure, except on the East front, where the pillars of the colonnade are of dull sandstone, upon which the cleaner can have little or no effect.

The liquid is applied with whitewash brushes by men working from suspended scaffolds, and the stone is then flushed off with water from a hose. When the water strikes the treated stone, the stains disappear as if by magic. Very little rubbing is necessary, except on greatly discolored surfaces.

The cleaner, of course, has practically no effect on porous stones, as their discoloration always extends far below the surface. Contrary to what might be expected, the cleaner has no injurious effect upon paint or varnish. Discolored woodwork may be cleaned with it, as well as stone.

The formula of the cleaner is being kept a secret, pending the issuance of United States and foreign patents, but is known to be of an acetous nature.

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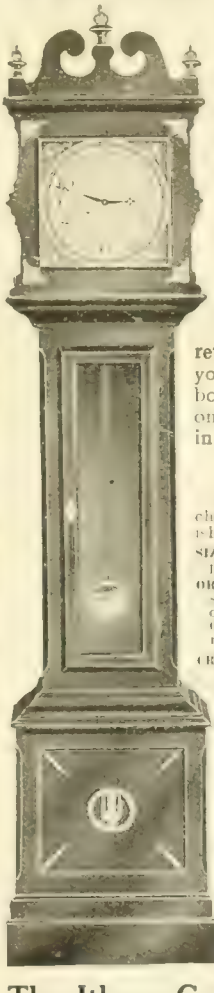

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Constructed of polished cherry, mahogany, or polished, selected oak.

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CAUTION: WE GUARANTEE our claims for "NEW-SKIN". No one guarantees substitutes or imitations trading on our reputation, and the guarantee of an imitator would be worthless any way.

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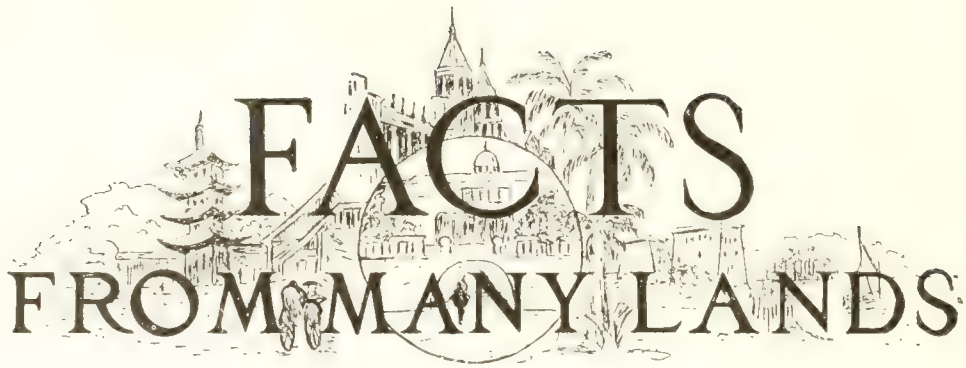


### New Wireless System

THE eminent German electrical engineer, Herr Rukmer, has invented a new system of wireless telegraphy, which is claimed to have the advantages of cheapness, reliability, and secrecy.

The sending device includes a larger parabolic reflector, in the center of which is an arc light; and the receiver is another reflector, which catches the luminous rays and concentrates them again, throwing them upon a selenium cell. The oscillations in the rays produce in this cell variations of resistance, resulting in a humming noise in the receiving telephones to which the cell is connected. This humming is cut by the Morse key into the long and short signals of the Morse code. The apparatus is available, of course, only for transmission over short distances.

### World's Largest Picture

A FRENCH artist, M. Roussel Geo, has completed the largest picture ever painted. It measures exactly 807 square feet. The artist had to beg the loan of a studio of suitable size from the State; and he and his easels, some 20 feet high, were accommodated in the Galérie des Machines, the largest one-spanned building in the world. The picture represents the Paris crowd in 1789 rushing to the Hotel de Ville, led by Lafayette, after the taking of the Bastile, and contains over 1,000 life-size figures. It will be hung in the town hall of Ivry, near Paris.

### Chinchilla Skins

THE chinchilla, so much prized for its beautiful, silken, light-gray fur, is found only in the Cordillera ranges of the Andes in Bolivia and Chile. It is a small animal which burrows in the ground, and in appearance somewhat resembles a rat.

In recent years so great has been the demand for this fur, that the animals have been hunted both in season and out of season to such an extent that they are now threatened with extinction. They are captured in various ways; but the most common method is to hunt them with dogs, the fox terrier being the most useful and skillful for this purpose.

The shipping season covers the months of January and July; and the product both of Chile and of Bolivia, is exported mainly from the port of Coquimbo, Chile. From this port, 144,000 skins were shipped last year, the majority of which came to the United States, the prices realized being almost double those paid the year previous.

A protective law establishing a close season was passed at the last session of the Chilean Congress; but on account of the natural habitat of the chinchilla in the wilds of the lofty Andes mountains, it is difficult to detect and convict violators of the law. It seems probable that this valuable fur-producing animal is destined to early extinction.

### Strength of Hair

BLACK hair is stronger than golden tresses, and will sustain almost double the weight.

Recently a scientist found, by experiment, that it is possible to suspend a weight of 4 ounces by a single hair, providing the hair be black. Blonde hair will give way at weights varying according to the tint. A yellow hair will scarcely support two ounces, a brown will hold up three without breaking, while one of a very dark brown will sustain an additional half-ounce.

### World's Oldest Ruins

THE oldest architectural ruins in the world are believed to be the rock-cut temples at Ipsampool, on the left bank of the Nile, in Nubia. The largest of these ancient temples contains fourteen apartments hewn out of solid stone. The ruins are supposed to be 4,000 years old.

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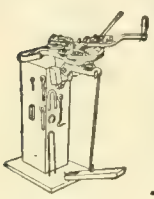

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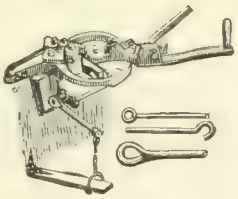

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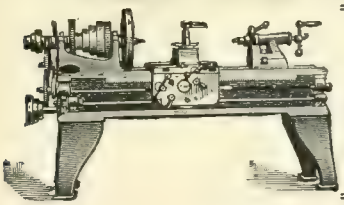

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### Machinery in Peru

THE preference shown in the South American Republics in general for products of European rather than American manufacture, has long been well known. It is not over-difficult to see why this is the case, and to locate the causes that have given Europe

M. Constantini and His Motor Skates.

The inventor is wearing the operating belt with fuel tank.

by far the greatest share in the trade of these countries.

They are, in the first place, the lack of direct shipping facilities and the high freight rates between North and South American ports; and in the second place, to what may seem an amazing deficiency in business foresight on the part of Americans, who fall far behind their European competitors in studying and in making effort to meet the conditions of the local demand. As a significant instance of this, we may mention the traffic in traction and plowing engines. The American goods are excellent in themselves, but have one defect in Peru, where fuel is both scarce and expensive. They are almost invariably made high-pressure instead of compound (that is both high and low). The first cost of a compound-pressure engine, it is true, may be greater, but in Peru the great economy in working expenses more than compensates for that. If some of the American makers would take note of this and act accordingly, a much larger business would be done. The extension of a credit system would also have important results.

### Germany's Drink Bill

THE money spent in Germany on drink is three times the cost of the army and navy together, and more than seven times the cost of their primary education. Its amount is almost equal to that of the German national debt; and so the German people, by leaving off drink for a year and a month, could pay off the whole debt.

### Vegetable Soap

ARRANGEMENTS have been made in Algeria to manufacture soap on a large scale from the fruit of the *Sapindus utilis*, a tree growing in that country, Japan, China, and India. This fruit, smooth and round, about the size of a horse chestnut, has a dark inner part and an oily kernel. By the use of water or alcohol, its saponaceous constituents can be extracted, and a product manufactured free from alkaline properties.

The tree bears fruit in its sixth year, yielding from 55 to 220 pounds. This fruit can be harvested easily in the fall.

### Automobile Skates

THE accompanying illustration is a photograph of Mr. Alfonso Constantini, an Italian living in Paris, and a pair of the automobile skates of his invention, which attracted much attention at the last Paris *Salon*.

Each skate has four 8-inch wheels, operated by an air-cooled motor of 1½ horse-power. The gasoline tank—holding about a pint and a-half, sufficient for a run of 46 miles—is carried on a belt around the skater's waist; and to it are attached the ignition battery, the throttle lever, and the spark control.

A speed of 31 miles an hour, it is said, can be attained; but the operator, with his left hand on the throttle lever, is able to regulate the speed from 3 miles an hour up. He can also climb hills of moderate steepness.

Skates with less powerful motors are now being built.

### Japan's Greatest Industry

THE greatest industry in Japan is textile, there being some 4,537 factories of various sizes engaged in this trade, the majority being centered in and around Osaka. These are mostly worked by steam power.

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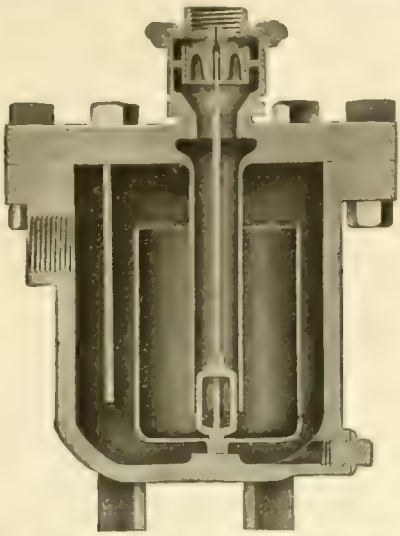

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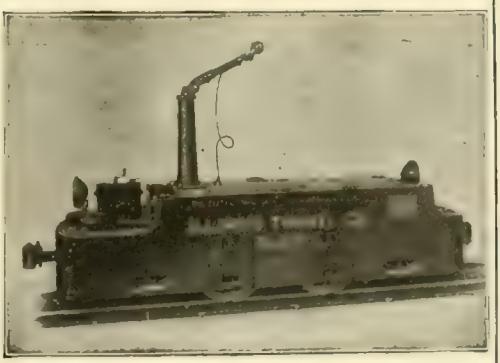

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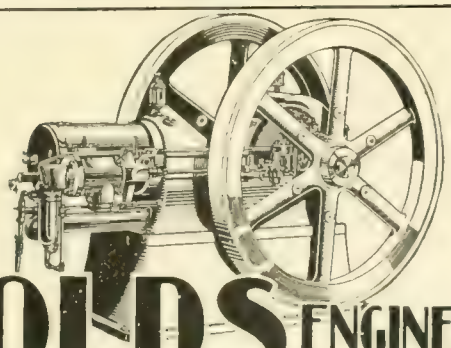

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FACTS FROM MANY LANDS (Concluded)

### Profitable Seaweed

ON the southwestern coast of Norway a very profitable industry has been developed in recent years, which, as a source of income, surpasses the far-famed fisheries of that northern land. It consists in gathering the immense quantities of seaweed which every fall are driven by the tides upon the beach, and subsequently burning the material and gathering the ashes, which bring a good price in the English market. The ashes contain many valuable chemical constituents, among which iodine is the most important.

The growth of seaweed along these shores is marvelous, the plant attaining the dimensions of trees five or six feet in height with stems like ropes and leaves as tough as leather. The growth is so thick that during the summer the ocean bed is covered with a dense, impenetrable brush, which later loses its grasp upon the soil and is drifted ashore. Quantities of the weed are used for fertilizing purposes, but the greater portion is carefully kept until spring, when it is burned for the purpose above stated.

All members of the household assist in the work at the busy season, when, on each clear night, the coast for miles seems to be aflame from the thousands of bonfires.

### Gathering Amber

AMBER is supposed to be gum which exuded from trees that in some former geological age covered certain parts of the earth's surface, but of which now not a vestige remains. In corroboration of this theory, we have the evidence of insects found imbedded in the amber, showing every evidence of having struggled hard to free themselves from the sticky substance upon which they had alighted or had been driven.

The shores of the Baltic Sea are the world's principal source of amber. Here a large number of people earn a precarious livelihood by gathering the precious substance along the shore. They work only in rough weather, for it is only then that the boulders are tossed and tumbled on the bottom and great quantities of submarine vegetation dislodged, hidden among the roots and branches of which are the lumps of the precious gum. At some points along the coast, divers search the bottom of the sea for lumps of amber hidden in seaweed or jammed between rocks.

The largest piece ever found weighed 18 pounds, valued at $30,000. It is now in the Royal Museum in Berlin. The usual finds range from particles as fine as grains of sand up to lumps the size of a man's head. Amber is used extensively for ornaments, and especially for the mouth-pieces of pipes.

### Atmospheric Nitrogen

IF the announcement recently made from Norway is substantiated—namely, that in that country a method of extracting nitrogen from the atmosphere by mechanical and chemical means, and utilizing it for the manufacture of nitrate fertilizers—it will certainly herald a revolution in agriculture, since it will mean unlimited quantities of fertilizing material at low cost. The next important advance will be the devising of a method of using water for fuel—that is, of course, decomposing it, and applying the oxygen, which forms eight-ninths of its weight, to assist in the processes of combustion.

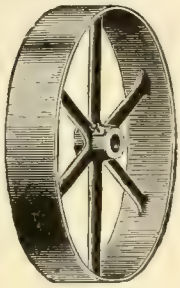
### Oil for Stormy Seas

OIL for quieting the sea has been in use for many years, but a novel means of applying the oil has been devised by Vice-Admiral Guimares, of the Brazilian navy, who has made a "bottle gun" for the purpose of doing this work. In case of a very turbulent sea, the gun is loaded with a bottle containing sawdust soaked with oil. The discharge of the weapon breaks the bottle into innumerable pieces, the contents are scattered over the surface of the sea for some considerable distance, and the effect on the troubled water is at once noticeable. If this operation is followed at intervals of five minutes, and the missile shot ahead of the boat, a peaceful path is prepared for the craft; and if she is at anchor or lying-to, one round every twenty minutes is said to be ample.

### South American Nitrate Beds

THE famous nitrate beds of Chile and Peru, located within the first range of foothills of the Andes, are a source of great wealth to these republics, and furnish a large share of the world's supply of nitrates. Most of the product exported is used in the manufacture of fertilizers, but part goes to the making of powder and high explosives.

The crude nitrate, known as "caliche," is found in strata a few feet below the surface of the barren pampas. It looks like rock salt, and varies in color, according to the purity of the deposit, from white to dark gray. The upper earth is blown away with dynamite, and the caliche is taken out, and with picks and shovels is loaded on cars and taken to the mills. Here it is crushed, and then put into large boiling vats, whose temperance is regulated by means of steam coils. Sea water is poured in, and the mixture boiled for a certain time. The resulting material is drawn off into settling vats, and evaporated by the sun. The pure nitrate of soda soon begins to crystallize and settle to the bottom. When this has gone on for some time, the remaining liquid is drawn off, and the crystals of nitrate are scraped from the sides and bottom of the vats and thoroughly dried in the sun. The product is then graded according to quality, and packed for shipment in 100-pound sacks.



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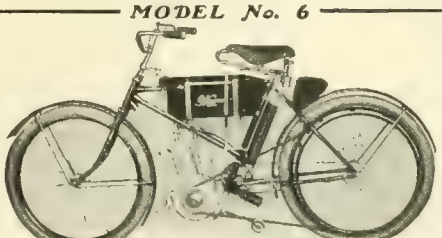

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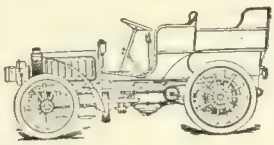

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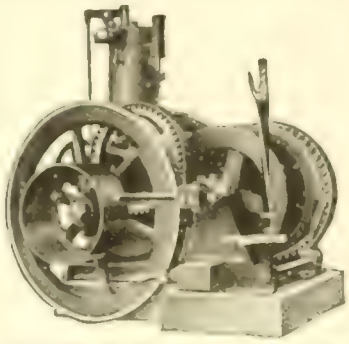

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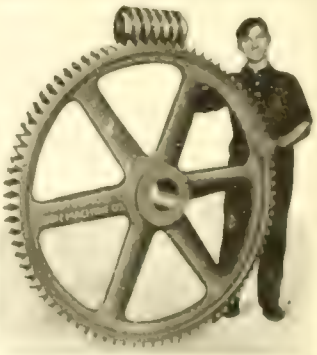

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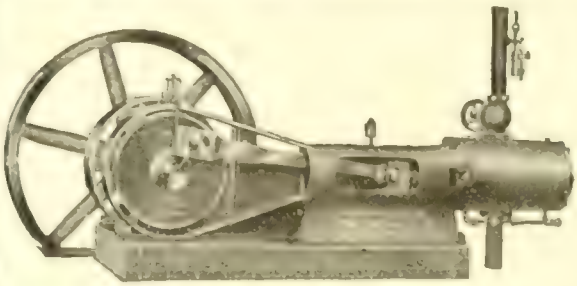

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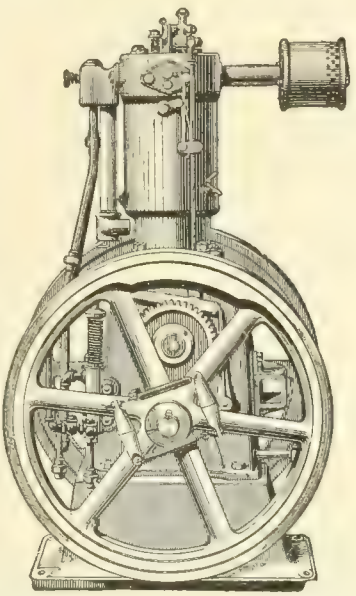

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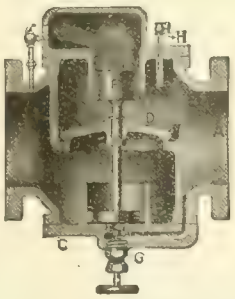

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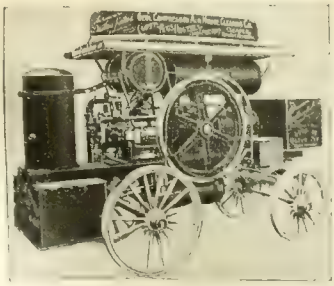

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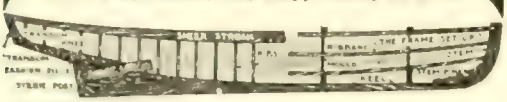

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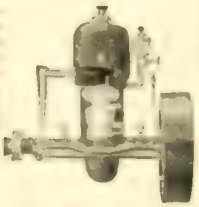

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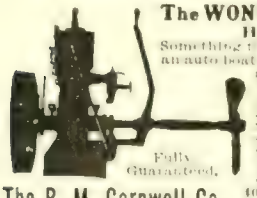

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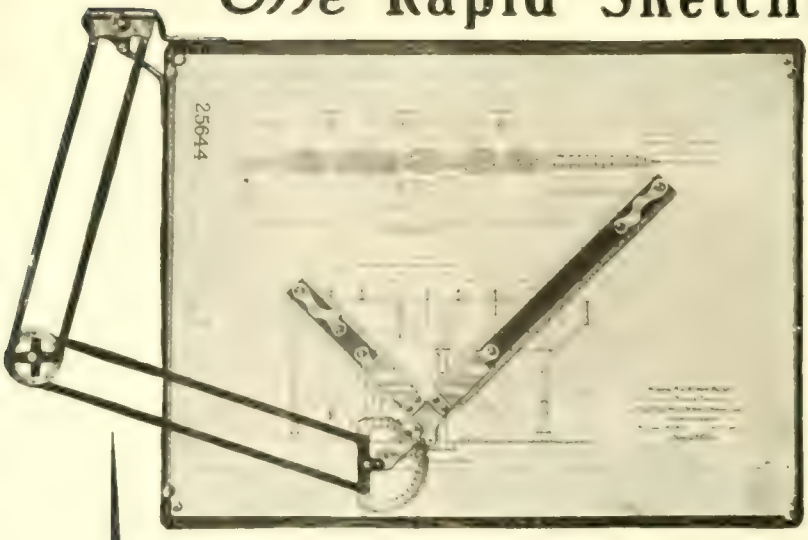


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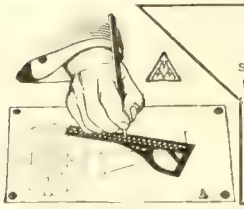

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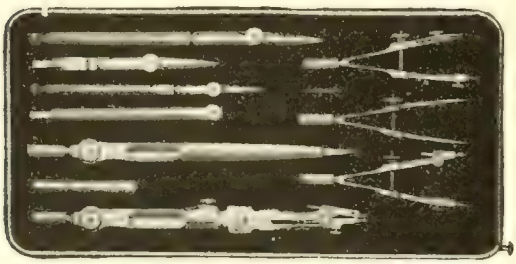

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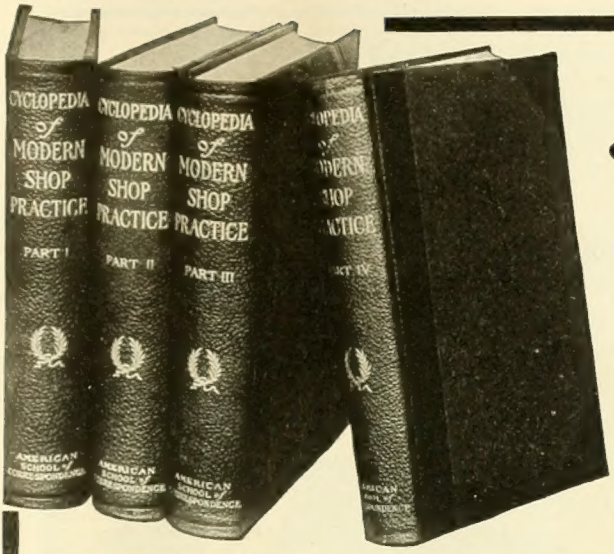


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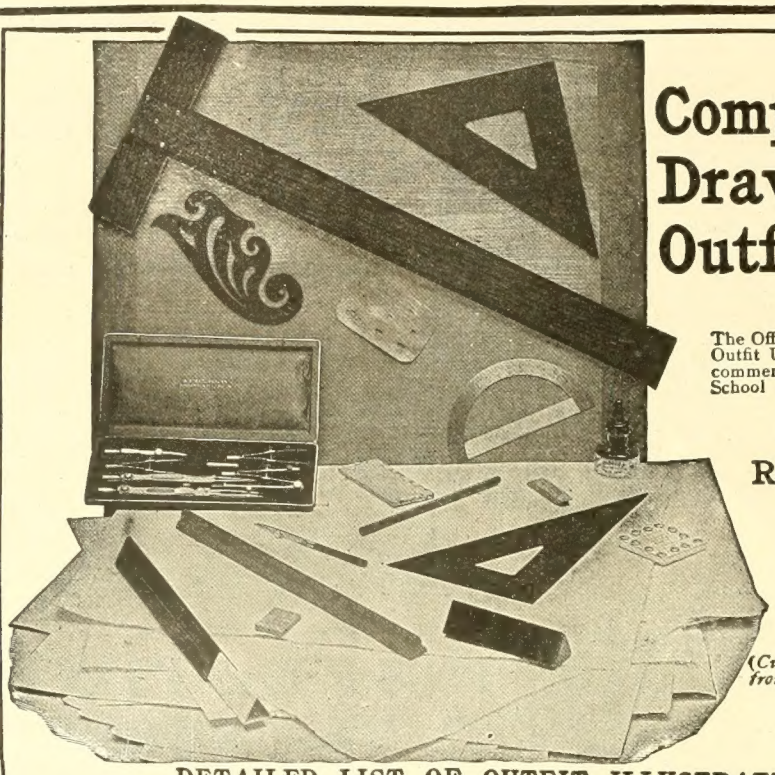

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| One Drawing Board, 19x25 inches, seasoned pine, with end battens, tongued and grooved, shellac finish, | $1.50 |
| One Mahogany T-Square, 24 in. long, ebony lined, fixed head, shellac finish, | .90 |
| One 45° Transparent Triangle, 8 inch, | .45 |
| One 30°x60° Transparent Triangle, 10 inch, | .50 |
| One 12-inch Triangular Boxwood Scale, engine divided; graduated 3-32, 3-16, 1-8, 1-4, 3-8, 3-4, 1-2, 1 1-2, and 3 inches to the foot, and one edge inches and 16ths, with case, | 1.00 |
| One Transparent Combination, Irregular or French Curve, special. | .65 |
| One Bottle Waterproof Ink | .25 |
| One 4-H Siberian Drawing Pencil, | .10 |
| One Faber's Ink Eraser, No. 1075, | .05 |
| One Faber's Pencil Eraser, No. 111, | .05 |
| One dozen Thumbtacks, | .20 |
| Nine sheets Whatman's handmade, cold pressed, Drawing Paper, 13½x20 inches, | .54 |
| Twelve sheets Whitstock Drawing Paper, 11x15 inches (for practice work only), | .15 |
| One Nickel Plated Erasing Stencil, | .25 |
| One Sandpaper Block, | .10 |
| One 6-inch German Silver Protractor, ½°, | .90 |

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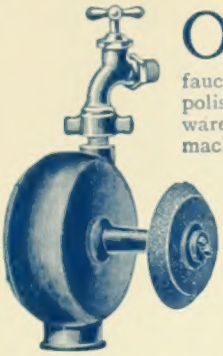

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